's LANDS PLANTENTUIN
(INSTITUTS SCIENTIFIQUES DE BUITENZORG)

TREUBIA

BIJDRAGEN OVER ZOÖLOGIE, HYDROBIOLOGIE EN OCEANOGRAPHIE VAN DEN OOST-INDISCHEN ARCHIPEL

ONDER REDACTIE VAN

Prof. Dr. L. G. M. BAAS BECKING
Directeur van 's Lands Plantentuin
te Buitenzorg.

Dr. J. D. F. HARDENBERG
Hoofd van het Laboratorium voor het
Onderzoek der Zee te Batavia.

en

M. A. LIEFTINCK
Hoofd van het Zoölogisch Museum
en Laboratorium te Buitenzorg.

DEEL 17

1939 — 1940

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INHOUD

Treubia Deel 17.

Correction-slip

TREUBIA DEEL 16, 1938, AFL. 4.

Corrigenda:

Page 491, Line 4 from foot of page, for *Miorhiza*, read: *Ophiorrhiza*.

Page 495, Line 5 from foot of page, for G. Lande, read: G. Lawoe (= Mt. Lawoe, in the Residency Madioen, East Java).

SHELLS FROM PREHISTORIC KITCHEN-MIDDENS IN SOME CAVES IN CELEBES.

By

W. S. S. VAN BENTHEM JUTTING

(Zoological Museum, Amsterdam).

For some years the Archaeological Survey of the Netherlands Indies has been exploring various caves in the Island of Celebes, where the occurrence of prehistoric settlements was proved or supposed.

Under the leadership of the late Dr. P. V. VAN STEIN CALLENFELS, at that time Head of the Archaeological Survey, excavations were made in a Cave North of Tjani, in South Bone, in 1934, and in the Cave of Panganrejang Toedeja, near Bonthain, 1937. In both caves shells and shell-fragments were found. Some of these were evidently collected by the primitive inhabitants for food or ornamental purposes. The presence of others, however, must be regarded as merely casual, introduced accidentally by man or animals, or by the agency of inanimate forces such as water, wind or earthfalls.

The shells were presented to the Zoological Museum of Buitenzorg, Java. The Director of this Institute, Dr. K. W. DAMMERMAN, transmitted them to me for identification and discussion.

In the same Southern fork of Celebes, at a little distance from the grottoes just mentioned, excavations were also carried out by Dr. VAN STEIN CALLENFELS and his collaborators in a cave near Tjita. On these operations a preliminary report was published: "Archaeologisch Onderzoek in Celebes" (Tijdschr. Kon. Ned. Aardr. Genootsch. (2) Vol. 60, 1938, p. 138 - 142). At p. 140 of this account reference is made to a kind of scraper with handle, and to arrow-heads and curved hooks all made from the shell of a large landsnail. The snail is not named, but similar objects are instanced, collected about 35 years earlier by Messrs P. and F. SARASIN when exploring Toala-caves in Celebes (Versuch einer Anthropologie der Insel Celebes. I. Die Toala-Höhlen von Lamotjong, Wiesbaden 1905).

These two authors described the snail as *Nanina toalarum* (nowadays *Hemiplecta toalarum*), and although I have not seen the implements which Dr. VAN STEIN CALLENFELS collected, it seems reasonably safe to assume that his objects belong to the same species.

In the paper of Messrs. SARASIN eight other species of molluscs were mentioned together with *Hemiplecta toalarum*. Of these three were probably used for (*Cyrena suborbicularis, Batissa violacea* and *Melania perfecta*), the others introduced accidentally (*Cyclotus politus, C. celebensis, Nanina* (*Hemiplecta*) *ribbei, Obba marginata sororcula* and *Planispira zodiacus*).

The spoils which I received for identification contained a much larger number of species. The following is a list:

Cave North of Tjani, South Bone, 1934.
(Specimens bearing a number above 200 were found in the lower layer).

Thiara robusta (MRTS) 1 spec., entirely fresh and undamaged, probably introduced in recent years.
Hemiplecta rugata MRTS 2 fragments of ultimate whorl (No. 543).
Xesta sp. 2 fragments, perhaps *X. nitida* MLLDFF.? suggesting a species with rather inflated whorls and relatively narrow base (No. 534).
Planispira zodiacus tuba (ALBERS) 1 spec., in good condition although a little bleached (No. S. 246).

Cave of Panganrejang Toedeja, near Bonthain, 1937.
(The shells from the upper layers A-B are younger than those from the lower layers C-D).

Name of species.	Layer A-B	Layer C-D
Trochus fenestratus GEML.	—	fragm. of shell-base
Turbo cinereus BORN	7 shells, more or less damaged, 1 fragm., 1 operculum	1 shell, a little damaged at aperture
Nerita albicilla L.	1 shell	—
Nerita planospira ANTON	—	fragm. of aperture
Theodoxus subpunctatus (RÉCL.)	3 spec., tops of shells broken away	—
Cyclotus pyrostoma SMITH	—	1 spec., rather small, high 10.6, broad 17.8 mm (including peristome)
Telescopium telescopium (L.)	5 fragments	2 fragm.: 1 spire (± 8 whorls) and 1 basal part with the characteristic plicae
Terebralia palustris (BRUG.)	1 fragm., with aperture	—
Terebralia sulcata (BORN)	1 fragment	—
Thiara crenulata DESH.	lower part of large specimen	—
Strombus isabella LAM.	1 fragm. of last whorl	—
Murex capucinus LAM.	2 fragm. with aperture	small fragm. of columella and siphonal funnel
Murex adustus LAM.	—	part of aperture
Drupa buccinea (DESH.)	fragm. of aperture	—
Arca helblingi BRUG.	1 fragm.	—
Arca sp.	—	fragm., probably *Arca*
Glycymeris amboinensis (GMEL.)	—	1 fragm., with part of hinge
Ostrea hyotis (L.)	1 single valve	—
Ostrea (*gryphoides* SCHLOTH.?)	1 single valve	—
Ostrea cucullata BORN	1 single valve and 2 fragm.	—

Name of species	Layer A-B	Layer C-D
Ostrea sp.	15 fragments	5 fragments, small
Polymesoda (cf. *expansa* Mouss.)	10 fragments	4 fragm., only 3 with part of the hinge
Batissa (probably *violacea* Lam.)	1 fragm. of large spec., with part of the hinge	—
Megaxinus corrugatus (Desh.)	1 fragment	3 small fragments
Gafrarium tumidum (Röd.)	3 single valves	—
Katelysia opima (Gmelin)	1 fragment	—
Venerupis variegatus (Sow.)	1 single valve, damaged	—
Asaphis dichotoma (Anton)	3 fragments	—
Psammobia sp.	1 fragment, with hinge	—

The shells from the first Cave (at some distance from the shore) are all non-marine, those from the Cave of Panganrejang Toedeja (close to the sea) nearly all marine, with the exception of *Cyclotus pyrostoma* (land) and *Theodoxus subpunctatus* and *Thiara crenulata* (fresh water). The specimen of *Cyclotus pyrostoma* I consider as accidentally washed into the cave. The other species are in all likelihood food remains. This is proved by the fact that in nearly all the Gastropods the spires are missing. These parts of the shells were probably crushed by pounding with a large stone. There are no signs of burning.

The marine shells are common species on the coral reefs and in the mangrove swamps throughout the entire Archipelago, and will certainly have occurred at the sea side near Bonthain in the days of the ancient cave inhabitants. Therefore these people were not obliged to wander far and wide, but could ransack the reefs near by in search of appetizing shell-fish.

NEUE LYCIDEN VON DEN ORIENTALISCHEN INSELN UND MOLUKKEN.

Von

R. KLEINE

(Stettin).

Insel Nias.

Lycostomus blandus n. sp. (Fig. 1 - 2).

Abdomen, Prothorax, Rüssel, Elytren, 1. - 3. Fühlerglied, Hüften und Schenkelbasis aller Beine schmutzig-orange. Rüssel länger als an der Basis breit. 3. Fühlerglied länger als das folgende, vom 3. - 11. nehmen die Glieder an Länge ständig ab, vom 9. ab auch etwas an Breite, Behaarung kurz und dicht, an der schwachen Zähnung der Glieder stehen einige grössere Haare. Prothorax länger als breit (Fig. 1). Schildchen fünfeckig, am Hinterrand gerade. Auf den Elytren ist die 3. Rippe vorn und hinten verkürzt, im übrigen sind Rippen und Skulptur recht deutlich.

Länge: 10 - 12 mm. Breite (hum.): 3 mm circa.

Nias. Aus Sammlung Fry. 4 ♀. Typus im Britischen Museum, Paratypus in meiner Sammlung.

Insel Enggano.

Metriorrhynchus enganicus n. sp.

Es besteht habituell grosse Aehnlichkeit mit *inaequalis* Fabr. Unterseite des Körpers und die Beine stahlblau, Kopf, Fühler und Schildchen blauschwarz. Prothorax schwarz mit mehr oder weniger deutlichen roten Flecken im Bereich der Seitenrandsareolen, Elytren tiefziegelrot bis blutrot, Hinterrand $^1/_4$ - $^1/_5$ schwarz. Kopf und Fühler ohne besondere Merkmale. Prothorax quadratisch, Hinterecken wenig vorgezogen, Areolen sehr deutlich, Randpunktierung dicht, deutlich. Schildchen tief, halbkreisförmig eingeschnitten. Elytren mit sehr kräftig ausgebildeten Rippen und gleicher, ausgesprochen querrechteckiger Gitterung, Rippen und Gitterung dicht behaart.

Länge: 12 - 16 mm. Breite (hum.): 2.5 - 3.5 mm.

Enggano, V-VII.1936 (Dr. J. K. de Jong).

15 ♀♀. Typus im Museum zu Leiden, Paratypus in meiner Sammlung.

Die Art ist sehr konstant und fällt sofort gegen *inaequalis* auf. Die Mentawei-Gruppe scheint eine sehr eigentümliche Inselfauna zu besitzen. Bei den viel weniger lokalen Brenthiden kann man dieselbe Feststellung machen.

Sumatra.

Lycostomus dohrni n. sp. (Fig. 3 - 4).

Schwarzbraun, Basis der Schenkel, Brust, Rüssel, 1. - 3. Fühlerglied dunkelbraun, Prothorax, Schildchen und die Elytren schmutzig-orange, letztere am Hinterrand in etwa $\frac{1}{4}$ der Länge schwarz. Fühlerbeulen schwach entwickelt, flach, in der Mitte nicht getrennt, darüber etwas vertieft, Rüssel doppelt so lang wie an der Basis. Fühler schlank, 1. - 5. Glied (Fig. 4), nach vorn zu werden die Glieder kürzer und schmaler, Behaarung sehr schwach. Prothorax höher als breit (Fig. 3), sehr flach, nur die Seitenränder in der hinteren Hälfte nach oben umgebogen, Skulptur grob und sehr flach. Schildchen zungenförmig, hinten gerade. Auf den Elytren ist die 3. Rippe an der Basis verloschen, auch die 2. ist undeutlich, in der hinteren Hälfte dagegen sind alle Rippen voll entwickelt, Gitterung sehr deutlich, runzelig. Allgemeine Behaarung sehr schwach.

Länge: 12 mm. Breite (hum.): 3 mm.

Deli, Soekaranda, Januar 1894 (DOHRN). Typus (♂) im Stettiner Museum.

BOURGEOIS hat das Tier bereits vor Jahren gesehen, aber nicht beschrieben. Ich habe den von ihm gewählten Namen beibehalten.

Cautires egenus n. sp. (Fig. 5).

Schwarzbraun, Prothorax und Schildchen zuweilen heller braun, Elytren in den basalen $\frac{1}{2}$ - $\frac{2}{3}$ mit rotbrauner Gitterung und gleichgefärbten Rippen, sonst schwarzbraun. Lamellen der männlichen Fühlerglieder etwas länger als das Glied selbst, die weiblichen Fühlerglieder tief gezahnt, sehr kräftig. Prothorax etwa quadratisch, Vorderrand steil abfallend, Vorderecken rund aber deutlich, Seiten gerade, Hinterrand in der Mitte etwas vorgezogen, Areolen kräftig, zuweilen sind auch die seitlichen erkennbar, Skulptur grob, durch dichte Behaarung manchmal verdeckt. Schildchen verkehrt-herzförmig, hinten tief, schmal eingebuchtet. Elytren mit sehr unregelmässiger Gitterung, die nur an Basis und Spitze regulärer wird.

Länge: 10 - 11 mm. Breite (hum.): 2 mm circa.

Deli, Soekaranda (DOHRN).

1 ♂, 2 ♀♀. Typus in meiner Sammlung.

Diese robuste Art ist nur mit den wenigen Arten der Sunda-Inseln zu vergleichen, deren Elytrengrund dunkel bei heller Färbung der Rippen und Gitterung sind. Der Unterschied ist aber leicht festzustellen, denn nur *egenus* hat unregelmässig gegitterte Elytren und nähert sich damit stark *Procautires*.

Cautires fehsei n. sp. (Fig. 6 - 7).

Tiefschwarz, Elytren, mit Aushnahme eines schmalen Basalteiles tiefziegelrot. Kopf mit halbkreisförmig vertiefter Stirn, Fühlerbeulen flach. Fühlerglieder tief gezahnt, dicht kurz behaart. Prothorax Fig. 7, Seitenareolen nicht ganz fehlend, die übrigen scharfkantig. Schildchen zungenförmig, am Hinterrand tief eingebuchtet. Auf den Elytren sind Rippen und Gitterung durch dichte, kurze Behaarung völlig verdeckt.

Länge: 11 mm. Breite (hum.): 2.5 mm.

Deli, Sibolangit, 1400 m, V.1929 (W. ROEPKE).

1 ♀. Typus in meiner Sammlung.

Die Ausfärbung erinnert an manche Arten aus den Bergen Borneos. Namentlich deutet die Schwarzfärbung an der Elytrenbasis darauf hin. Sehr eigenartig ist auch die starke Behaarung der ganzen Körperoberseite.

Diese eigenartige, von Sumatra ganz unbekannte Form widme ich meinem Kollegen O. FEHSE in Thale a. H.

Cautires hilaris n. sp. (Fig. 8 - 9).

Schwarz, Elytren orange, nur der Hinterrand mit schmalem, schwarzem Anflug. Prothorax (Fig. 8), Seitenareolen fehlen gänzlich, die Ränder, namentlich nach hinten, behaart. Schildchen am Hinterrand tief eingebuchtet, dicht behaart. Elytren mit dichter Behaarung, so dass die Skulptur ganz verdeckt ist.

Länge: 13 mm. Breite (hum.): 3 mm.

1 ♀. Typus in meiner Sammlung.

Die Art fällt durch die Ausfärbung etwas aus dem Rahmen der sumatranischen Gattungsgenossen heraus. Sie repräsentiert mehr einen Typus, der sich in den Bergen Borneos wiederfindet. Auffallend ist die dichte Behaarung, namentlich auf den Elytren. Verwechslung mit einer anderen Art ist nicht gut möglich.

Leptotrichalus pervicax n. sp.

Erdgrau, Elytren im basalen Drittel etwas heller, gegen die Mitte allmählich dunkler werdend. Stirn über den deutlichen Fühlerbeulen flach eingedrückt. Fühler schlank, vom 3. Glied ab an Länge abnehmend, schwach gezahnt, basale Glieder fast ungezahnt. Areole des Prothorax vorn geschlossen, Seitenränder stark erhöht. Schildchen verkehrt-herzförmig. Elytrengitterung 4-5eckig, die Figuren häufig länger als breit.

Länge: 10 mm. Breite (hum.): 1.5 mm circa.

Deli, Brastagi, 1300 m, 14.2.1921 (J. B. CORPORAAL).

Typus in meiner Sammlung.

In dieser Ausfärbung ist nur eine Art von den Philippinen bekannt, sie weicht vom Sumatratyp stark ab.

Melampyrus dohrni n. sp. (Fig. 10 - 11).

Sammetschwarz, matt, Prothorax, Schildchen und die Elytren im basalen Drittel orangegelb; Oberseite des Körpers kurz, dicht behaart, Unterseite einzeln, lang behaart. Stirn flach, Fühlerbeulen desgleichen. Prothorax (Fig. 10), breiter als lang, Ränder nur an den Seiten und vornehmlich nach hinten zu erhöht, in der hinteren Hälfte mit tiefer Mittelfurche, Skulptur durch dichte Behaarung völlig verdeckt. Schildchen zungenförmig, am Hinterrand etwas eingebuchtet. Elytren dicht behaart, so dass Rippen und Gitterung nur unscharf erkennbar sind.

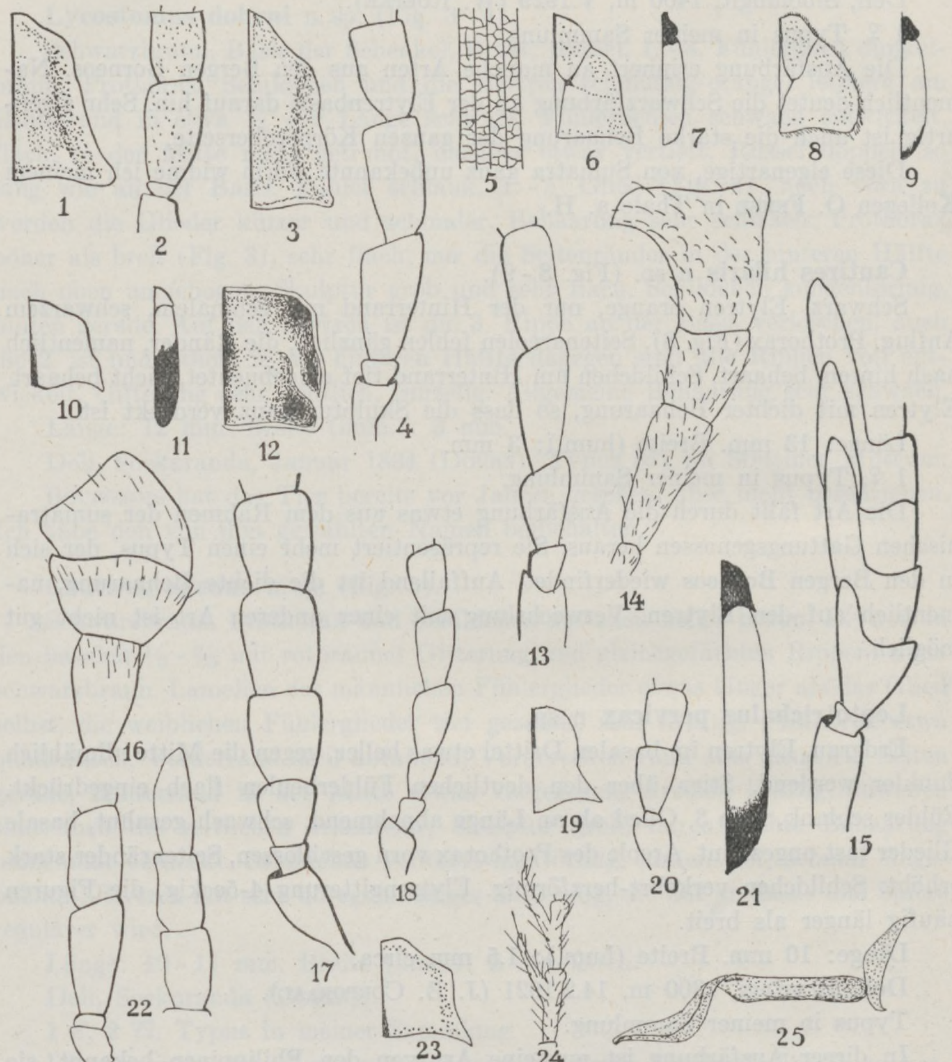

Fig. 1 - 2. *Lycostomus blandus,* n. sp., Prothorax und 1. - 4. Fühlerglied. Fig. 3 - 4. *Lycostomus dohrni,* n. sp., Prothorax u. 1. - 5. Fühlerglied. Fig. 5. *Cautires egenus,* n. sp., Elytrengitterung. Fig. 6 - 7. *Cautires fehsei,* n. sp., Prothorax u. Farbenverteilung. Fig. 8 - 9. *Cautires hilaris,* n. sp., Prothorax u. Farbenverteilung. Fig. 10 - 11. *Melampyrus dohrni,* n. sp., Prothorax u. Farbenverteilung. Fig. 12 - 14. *Calochromus bryanti,* n. sp., Prothorax, Mandibulartaster (14) u. 1. - 5. Fühlerglied (13). Fig. 15. *Calochromus longepectinatus,* n. sp., 1. - 6. Fühlerglied. Fig. 16 - 17. *Calochromus firmus,* n. sp., Mandibulartaster u. 1. - 6. Fühlerglied. Fig. 18. *Calochromus dolosus,* n. sp., 1. - 6. Fühlerglied. Fig. 19 - 21. *Dilophotes mjöbergi,* n. sp., Prothorax, 1. - 4. Fühlerglied u. Farbenverteilung. Fig. 22. *Lycostomus lieftincki,* n. sp., 1. - 4. und 9. - 11. Fühlerglied. Fig. 23 - 25. *Ditoneces corneolus* n. sp., Prothorax, mittlere Fühlerglieder u. Penis.

Länge: 10 mm. Breite (hum.): 2 mm.

Deli, Berge Sinabong. Typus (♀) in meiner Sammlung.

Von allen *Melampyrus* durch die ganz eigenartige Ausfärbung gekennzeichnet. Eine derartige scharfe Trennung der beiden Farben wie sie sich hier auf den Elytren findet, ist nur noch bei *diversesignatus* KLN., wenn auch in anderer Anordnung, bekannt.

Insel Bali.

Xylobanus wittmeri n. sp.

Schwarz, Prothorax, Schildchen und Elytren orangerot. 3. - 10. Fühlerglied gezahnt, 3. etwa so breit wie lang, die folgenden an Breite, nicht an Länge abnehmend, 11. nur so lang wie das 10. Prothorax so hoch wie am Hinterrand breit, Vorderecken gerundet, Seiten gerade, Hinterecken etwas nach aussen vorgezogen, fünf Areolen, die seitlich fehlen, Behaarung sehr kurz, dicht. Schildchen verkehrt-herzförmig, Hinterrand tief eingebuchtet, dicht behaart. Elytren mit sehr kräftigen Rippen und gleicher, dichtquerer Gitterung.

Länge: 16 mm. Breite (hum.): 3 mm.

Ost-Bali: Batoeriti, 3500′, IV-V.1936 (WITTMER).

2 ♀♀. Typus in Sammlung WITTMER, Paratypus in meiner Sammlung.

Es besteht einige Aehnlichkeit mit *fastidiosus* C. O. WAT. die aber sieben Areolen hat. Dasselbe gilt für *horrendus* KLN. Beide Arten könnten auf Bali vorkommen. *Wittmeri* ist eine der grössten Arten die ich kennen gelernt habe und unter den einfarbigen überhaupt die weitaus grösste.

Borneo.

Melampyrus nanus n. sp.

Schwarz, auf dem Prothorax sind zuweilen die Ränder, auf den Elytren aber die Primärrippen an der Basis immer mehr oder weniger hellbraun. Stirn flach, abschüssig, Augen sehr prominent. Fühler schwach gezähnt, nach den vorderen Gliedern zu ungezähnt, überall kräftig, lang behaart. Prothorax am Hinterrand so breit wie in der Mitte hoch, mit tiefem Basaleindruck und kräftig erhöhten Rändern. Elytren dicht, sammetartig behaart, die Primärrippen im Basalteil verbreitert und aufgehellt.

Länge: 4 mm. Breite (hum.): 1 mm circa.

Sandakan (CH. FULLER-BAKER).

2 ♂♂. Typus in meiner Sammlung.

Diese kleine Art ist durch die Ausfärbung, durch die prominenten Augen und stark behaarten Fühler leicht erkennbar und mit keiner anderen zu verwechseln.

Calochromus bryanti n. sp. (Fig. 12 - 14).

Blauschwarz glänzend, Elytren in den vorderen ⅔ blutrot, am ganzen Körper glänzend. Stirn ohne Vertiefung mit schmaler Mittelfurche und flacher Punktierung, letztes Glied der Mandibulartaster hakenförmig (Fig. 14). Fühler

(Fig. 13), Glieder nach vorn an Länge und Breite langsam abnehmend, vom 6. ab schwach gezahnt, 11. länger als das 10., conisch-walzig, Behaarung sehr dicht und kurz. Prothorax (Fig. 12), Mittelfurche sehr tief, durchgehend, auch die seitlichen Vertiefungen stark entwickelt, unbehaart, sehr zart skulptiert. Schildchen am Hinterrand nicht eingekerbt, dicht behaart. Elytren mit deutlichen Primärrippen, Behaarung sehr dicht und kurz. Schenkel ungedornt.

Länge: 9 mm, Breite (hum.): 2½ mm.

W. Sarawak, Quop, 3.-4. 1914 (G. E. BRYANT).

1 ♂ Typus im Brit. Museum.

Die Art unterscheidet sich von allen ähnlichen durch die eigenartige Bildung der Mandibulartaster und ist daran leicht erkennbar.

Calochromus longepectinatus n. sp. (Fig. 15).

Schwarz, nur die Elytren in der vorderen Hälfte rot behaart, doch so, dass der schwarze Grund hindurch scheint. Stirn ungefurcht, zwischen den Fühlerbeulen kaum etwas vertieft, dicht dunkelrot behaart. Fühler schlank mit langen schmalen kammartigen Lamellen, die vom 3. Glied ab vorhanden, vom 4.-10. so lang oder länger als das Glied sind; Behaarung kurz (Fig. 15). Prothorax am Hinterrand etwas breiter als in der Mitte hoch, aber doch von fast quadratischer Form, am Vorderrand schmaler als am Hinterrand, daher nach hinten erweitert, alle Ecken stumpf, Mittelfurche auffallend breit und tief, nach den Rändern zu spitzer werdend, in der Mitte am breitesten, seitliche Eindrücke sehr tief, Behaarung kurz. Schildchen verkehrt herzförmig, hinten eingebuchtet. Elytren parallel, nur die Primärrippen sind sichtbar und auch diese nur schwach, Behaarung gering. Schenkel ungedornt.

Länge: 10 mm. Breite (hum.): 2 mm circa.

Sandakan (CH. FULLER-BAKER).

1 ♂ Typus in meiner Sammlung.

Durch die eigenartigen Fühler von allen *Calochromus*-Arten leicht zu unterscheiden.

Calochromus firmus n. sp. (Fig. 16-17).

Schwarz mit schwachem, kaum bemerkbarem bläulichen Schimmer, Elytren ziegelrot, am ganzen Körper glänzend. Stirn ohne Mittelfurche, erst vor den Augen beginnt eine Vertiefung, die sich zwischen den Fühlerbeulen fortsetzt, Skulptur gering, Mandibulartaster (Fig. 16). Fühler kurz, die Elytrenmitte nicht erreichend, 1.-6. Glied (Fig. 17), die folgenden an Breite, nicht an Länge abnehmend, nur das 9. ist kürzer als das 8. und 10., Behaarung kurz, dick. Prothorax viel breiter als lang, Seiten gerade, Vorder- und Hinterecken stumpf, Mittelfurche flach, aber durchgehend, seitliche Eindrücke flach, Behaarung dicht, kurz. Schildchen kurz, hinten flach eingebuchtet. Elytren nach hinten wenig erweitert, Primärrippen deutlich erkennbar, Sekundärrippen durch dichte Behaarung verdeckt. Schenkel ungedornt.

Länge: 11 mm. Breite (hum.): 2.5 mm.
Sandakan, August 1927.
1 ♀. Typus in meiner Sammlung.

Calochromus dolosus n. sp. (Fig. 18).

Schwarz, Elytren ziegelrot, schwach glänzend, Elytren matt. Stirn mit schmaler Furche, einzeln punktiert, in den Punkten behaart. Mandibulartaster kräftig, 3. Glied gross, beilförmig. 1.-6. Fühlerglied (Fig. 18), die folgenden bis zum 10. einschliesslich von gleicher Gestalt wie das 6., 11. etwas länger als das 10. Behaarung dicht. Prothorax quadratisch, Vorder- und Hinterecken stumpf, Seiten gerade, Mittelfurche schmal, den Vorderrand nicht erreichend. Schildchen zungenförmig. Elytren mit nur schwachen, durch dichte Behaarung stark verdeckte Rippen. Schenkel ungedornt.

Länge: 8 mm. Breite (hum.): 2 mm.
Mt. Matang, W. Sarawak.
1 ♀. Typus in meiner Sammlung.

An *firmus* sich anlehnend. Hauptunterschiede: Prothorax nicht stark quer, sondern quadratisch. Die Fühlerglieder sind nicht kurz und tief gezahnt, sondern schlank, ohne Zähnung. Habituell sind sich die Arten sehr ähnlich.

Dilophotes mjöbergi n. sp. (Fig. 19-21).

Von robuster Gestalt. Schwarz, Elytren in den basalen ⅔ lehmgelb. Stirn steil abfallend, ungefurcht, einzeln behaart, Fühlerbeulen deutlich. Fühler robust, 1.-4. Glied (Fig. 20), 4.-10. von gleicher Gestalt, 11. kaum verlängert. Prothorax am Hinterrand so breit wie in der Mitte hoch, Vorderkante gerundet, Seiten etwa in der Mitte nach innen eingebuchtet, Spitzen nach aussen schwach vorgezogen, Hinterrand kräftig geschwungen, Ränder scharf aufgebogen, vordere Hälfte tief punktiert, Mittelkiel stark entwickelt. Schildchen verkehrt-herzförmig, Hinterrand nicht eingebuchtet. Elytren dicht behaart, so dass die Skulptur verdeckt ist. 1. Rippe schwach, kaum die Hälfte der ganzen Länge erreichend, 2. sehr kräftig, durchgehend, 3. nur an der Basis stark, sonst schwach aber bis zum Hinterrand reichend.

Länge: 8 mm. Breite (hum.): 1.5 mm.
S.O. Borneo: Mt. Tibang, 1400 m (Mjöberg).
Typus, ♀ in meiner Sammlung.

Das Tier stammt aus Mjöberg's Gebirgsexpedition nach S.O. Borneo. Es gehört der eigentlichen Gebirgsfauna aber noch nicht an, wie das die Ausfärbung beweist. Die Gelbfärbung der hellen Körperteile ist für das S.O. Borneo-Gebiet charakteristisch. Bemerkenswert ist auch die gedrungene, robuste Gestalt.

Java.

Lycostomus lieftincki n. sp. (Fig. 22).

Abdomen schwarz mit rostroter Behaarung, Brust ganz rostrot, nur an den Seiten schwarz, Kopf schwarz, 2. Fühlerglied ganz, 3. zum Teil rotgelb, sonst sind die Fühler schwarz. Prothorax, Schildchen und Elytren hellziegelrot,

letztere am Hinterrand mit einem kleinen schwarzen Fleck. Beine schwarz, nur die Schenkel an der Basis in geringem Ausmass und die Hüften gelbrot behaart. Rüssel kaum länger als der Kopf, breit. Fühler robust, 1. - 4. und 9. - 11. Glied Fig. 22. Prothorax am Hinterrand breiter als in der Mitte hoch, Vorderrand dachförmig abfallend, Seiten nach aussen gebogen, Hinterecken rechteckig, Hinterrand nur wenig gewellt, Seiten flügelartig erhöht und daselbst grob, punktartig skulptiert. Schildchen zungenförmig, Hinterrand gerundet. Elytren mit deutlichen Rippen und gleicher Skulptur.

Länge: 14 mm. Breite (hum.): 4 mm.

W. Java, Depok, 100 m Höhe (M. A. LIEFTINCK).

1 ♀. Typus in meiner Sammlung.

Es besteht habituell Aehnlichkeit mit *moricii* FAIRM. und *rufiventris* C. O. WAT. Die Unterschiede sind gegen *moricii:* andere Ausfärbung, die Körperseite ist nicht rot wie bei jener Art, die Fühler sind anders gefärbt, die Glieder 1 - 4 sind ganz hell und die vorderen sind kürzer, selbst im männlichen Geschlecht. Rippenbildung und Skulptur ist viel robuster, so dass die Elytren nicht so glatt aussehen; die Form der schwarzen Hinterrandsflecken ist eine andere. Gegen *rufiventris:* zarter, schmaler, die Fühlerglieder sind total anders, vor allen Dingen schlanker und zarter. *Rufiventris* gehört habituell dem hinterindischen Verwandtschaftskreis an, *lieftincki* dem der Sunda-Inseln.

Trichalus antiquus n. sp.

Habituell und in der Ausfärbung *siccus* KLN. ähnlich. Schwarz, auf den Elytren sind im basalen Viertel die Rippen und zum Teil auch die Gitterung fuchsrot behaart. 3. - 11. Fühlerglied fast gleichlang, nach vorn ständig an Breite abnehmend, die basalen etwa so breit wie lang. Prothorax am Hinterrand so breit wie in der Mitte hoch, Vorderrand dachförmig abfallend, Seiten nach innen gebogen, Hinterecken spitz vorgezogen, die diskoidale Areole deutlich, die vorderen unscharf, die seitlichen fehlen. Schildchen verkehrt-herzförmig, am Hinterrand tief dreieckig eingebuchtet. Elytrengitterung, namentlich an der Basis, quer.

Länge: 7 mm. Breite (hum.): 1 mm.

W. Java, Mt. Panggerango, Tjisaroea, 1050 m, VII.1931 (M. A. LIEFTINCK).

1 ♀. Typus in meiner Sammlung.

Ditoneces corneolus n. sp. (Fig. 23 - 25).

Schwarzbraun, Schenkel und Beine an der Basis etwas aufgehellt, Kopf mit gelbbrauner Behaarung, Prothorax, Schildchen und Elytren strohgelb. Scheitel von Auge zu Auge breit elliptisch eingedrückt, Fühlerbeulen gross, breit, flach gefurcht; Augen sehr gross, prominent. Fühler schlank, mittlere Glieder Abbildung (Fig. 24); Lamellen etwa so lang wie das Glied selbst, lang, einzeln behaart. Prothorax Fig. 23. Schildchen verkehrt-herzförmig, Hinterrand nicht eingebuchtet. Elytren mit sehr deutlichen Rippen und 4 - 5eckiger Gitterung. Penis Fig. 25.

Länge: 6.5 mm. Breite (hum.): 1 mm circa.

M. Java, Djeroeklegi, Süd Banjoemas, XI.1932 (F. C. Drescher).

1 ♂. Typus in meiner Sammlung.

Durch die Form des Prothorax und des Penis von allen anderen gleichfarbigen Arten sicher zu unterscheiden.

Dihammatus preangeranus n. sp.

Schwarzbraun, Elytren im basalen Teil in wechselndem Umfang graugelb. Stirn mehr oder weniger tief und gross grubig eingedrückt, Fühlerbeulen deutlich. 2. und 3. Fühlerglied gleichlang, beide zusammen kürzer als das 4., 4. - 11. etwa von gleicher Länge, nach vorn nicht an Länge, wohl aber an Breite etwas abnehmend, die Glieder etwa 4 - 5 mal so lang wie breit. Prothorax quer, Vorderrand flach dachförmig abfallend, Ecken stumpf, Seiten gerade, Hinterecken spitz aber nicht vorstehend, Mittelfurche tief, Skulptur, namentlich am Vorderrand sehr kräftig. Schildchen zungenförmig, Hinterrand gerade. Elytren kurz, dicht behaart, die Skulptur dadurch nur undeutlich hervortretend.

Länge: 4 - 5 mm. Breite (hum.): 1 mm circa.

W. Java, Mt. Tangkoeban Prahoe, 12 - 1500 m; Mt. Gedeh, 1800 m, X.1935; Pasir Junghuhn, Mt. Malabar, 1600 m, VI.1936 (alles von Drescher gesammelt). Mt. Patoeha, 1800 m, IV.1936 (L. J. Toxopeus).

3 ♂♂, 3 ♀♀. Typen in meiner Sammlung.

Die schwarze Farbenpartie auf den Elytren wechselt sehr in der Ausdehnung, sie kann sich bis zur Hälfte erstrecken aber auch bis auf $^1/_6$ reduziert sein. Aehnlichkeit besteht nur mit *pilosus* Kln. von der die ganz andere Behaarung und die Form der Fühler trennen. Von der nächsten Art schon durch die Gestalt des 2. und 3. Fühlergliedes leicht zu trennen.

Dihammatus mundus n. sp.

Habituell mit *preangeranus* übereinstimmend. Durch folgende Merkmale unterschieden: Stirn durchgehend tief gefurcht, 3. Fühlerglied länger als das 2., beide zusammen so lang wie das 4., sonst gleich *preangeranus*. Prothorax in der hinteren Hälfte tief keilförmig gefurcht. Schildchen flach dreieckig eingekerbt. Elytren kaum behaart, die Skulptur daher deutlich.

Länge: 5 mm. Breite (hum.): 1 mm.

W. Java, Mt. Tangkoeban Prahoe, 12 - 1500 m, IX.1935 (F. C. Drescher).

1 ♀. Typus in meiner Sammlung.

Dihammatus putridus n. sp.

Schwarzbraun, Elytren in der basalen Hälfte hell-lehmgelb. Stirn nicht gewölbt, Fühlerbeulen schwach entwickelt. Fühler schlank, 3. Glied wenig länger als das 2., 4. länger als das 2. und 3. zusammen, 5. - 11. etwa gleichlang, nach vorn an Breite abnehmend. Prothorax quer, in der basalen Hälfte kräftig gefurcht, Randpunktierung zwar zart aber dicht und tief. Schildchen am Hinterrand gerade. Elytren sehr dicht behaart, so dass Rippen und Gitterung verdeckt bleiben.

Länge: 6.5 mm. Breite (hum.): 1.5 mm circa.

O. Java, Ranoe Pani (Tengger), 2100 m (E. HANDSCHIN).

2 ♀♀. Typus im Naturhist. Museum Basel.

Es besteht nur Aehnlichkeit mit *beccarii* BOURG. Die Ausfärbung ist aber in beiden Arten sehr verschieden. Leider lagen mir von *putridus* keine ♂♂ vor um den Penis zu vergleichen. Von *beccarii* habe ich grosse Reihen von Java gesehen und die Konstanz in der Ausfärbung festgestellt.

Libnetis tinctus n. sp.

Einfarbig schwarz, nur die Schultern in geringer Ausdehnung graugelb. Vor den Fühlerbeulen tief halbkreisförmig eingesenkt, Fühlerbeulen flach. Fühler gedrungen, 3. - 11. Glied allmählich an Länge, nicht an Breite abnehmend, das Glied mehrfach so lang wie breit, fast parallel, dicht aufsitzend. Prothorax nicht ganz einheitlich in Form, Hinterecken spitz, vor dem Hinterrand tief grubig-elliptisch eingedrückt, Ränder kräftig punktiert. Elytren ohne besondere Merkmale, unbehaart.

Länge: 4 mm. Breite (hum.): 0.75 mm.

O. Java, Mt. Raoeng, „Bajoekidoel", 450 - 700 m, I.1933 (H. LUCHT).

1 ♂♀. Typen in meiner Sammlung.

Es ist die erste schwarze Art von Java.

Dilophotes angusticollis n. sp. (Fig. 26 - 28).

Schwarz, Elytren orange, am Hinterrand in geringem Umfang schwarz, die schwarze Partie von der orangefarbenen scharf quer getrennt. Stirn schmal aber deutlich gefurcht, Fühlerbeulen kräftig. Fühler schlank, 3. - 11. Glied etwa gleich lang, circa vier mal so lang wie breit, parallel, nur an der Basis verengt, nicht gezahnt. Prothorax schlank, Vorderrand steil dachförmig abfallend, Vorderecken sehr deutlich, Seiten gerade, nach hinten schwach verbreitert, Hinterecken spitz nach aussen-hinten vorstehend, Hinterrand in der Mitte mässig stark vorgewölbt; vordere Hälfte kräftig punktiert und in der Mitte aufgekielt. Schildchen zungenförmig, hinten gerundet. 1. Elytrenrippe bis ins hintere Viertel reichend, 2. und 3. durchgehend, alle gleichstark, Skulptur durch kurze Behaarung etwas verdeckt.

Länge: 7.5. Breite (hum.): 1 mm circa.

W. Java, Mt. Tangkoeban Prahoe, 12 - 1500 m, VIII.1936 (F. C. DRESCHER).

2 ♂♂. Typus in meiner Sammlung.

Schon durch die Ausfärbung von allen anderen Arten leicht und sicher zu trennen.

Dilophotes dilaticollis n. sp. (Fig. 29 - 31).

Schwarz, Prothorax einzeln rot behaart, Elytren in den basalen ⅔ ziegelrot, der schwarze Spitzenteil nach vorn zackig verlaufend, an den Seiten am weitesten vorstehend. Kopf mit steiler Stirn, Fühlerbeulen ganz flach. Fühler mittelstark, 3. - 10. Glied etwa gleichlang, 11. wenig verlängert, Grundform gleichmässig

stumpf-keilförmig, ungezahnt. Prothorax am Hinterrand so breit wie in der Mitte hoch, Vorderrand gerundet, Seiten gerade, Hinterecken spitz vorgezogen, Hinterrand stark geschwungen, Vorderteil tief grubig skulptiert, stumpf gekielt. Schildchen zungenförmig, breit, hinten gerundet. 1. Rippe neben der Sutura stark verkürzt, 2. kräftig, durchgehend, 3. allgemein schwächer, im Spitzenteil verlöschend, Randrippe kräftig, Skulptur deutlich.

Länge: 7.5 mm. Breite (hum.): 1 mm circa.

W. Java, Mt. Tangkoeban Prahoe, 12 - 1500 m, VIII.1936 (F. C. DRESCHER).

1 ♀. Typus in meiner Sammlung.

Habituell besteht grosse Aehnlichkeit mit *fruhstorfferi* PIC von der sie sich durch andere Ausfärbung unterscheidet. Die Fühlerform ist in beiden Arten verschieden und in der Elytrenskulptur besteht keine Uebereinstimmung.

Flabellodilophotes luchti n. sp. (Fig. 32).

Schwarz, Elytren in der basalen Hälfte in wechselnder Ausdehnung lehmgelb. Prothorax erheblich länger als breit, Vorderrand gerundet, am Hinterrand mit tiefem mittlerem Eindruck und seitlichen tiefen Quereindrücken. Fühler sehr zart, 1. - 6. Fühlerglied Fig. 32. Elytren dicht und zart behaart.

Länge: 6 mm. Breite (hum.): 1 mm.

O. Java, Mt. Raoeng, „Bajoekidoel", 450 - 700 m (H. LUCHT).

3 ♂♂, 1 ♀.

Von der ähnlichen *dispar* KLN. durch die ganz anderen Fühler ausgezeichnet.

Celebes.

Lycostomus pallens n. sp. (Fig. 33 - 35).

Einfarbig bleichgelb, Schenkelspitzen der Vorder- und Mittelbeine, Schienen und Tarsen aller Beine, Mandibulartaster, Fühlerglieder vom 3. ab an den Kanten, vom 7. ab ganz hellbraun. Rüssel länger als an der Basis breit, am Mundrande gebräunt. Stirn neben den Augen mit zwei tiefen, punktartigen Eindrücken, überall dicht behaart. Fühler lang, 3. - 5. Glied Fig. 34, die folgenden an Länge und Breite abnehmend, vom 4. ab dicht behaart, an den Aussenseiten mit einzelnen langen, abstehenden Haaren. Prothorax Fig. 33. Schildchen keilförmig, am Hinterrand nicht eingekerbt, kurz behaart. Elytrenrippen von mittlerer Stärke, alle voll entwickelt, Gitterung zart. Penis Fig. 35.

Länge: 15 mm. Breite (hum.): 4 mm.

Süd-Celebes: Bantimoeroeng (bei Maros).

Typus in meiner Sammlung.

Xylobanus reverens n. sp. (Fig. 36 - 38).

Einfarbig tiefschwarz, glänzend. Stirn vertieft, Fühlerbeulen daher kräftig entwickelt. 2. - 10. Fühlerglied tief gezahnt, nach vorn an Breite, nicht an Länge nachlassend, kurz, dicht behaart. Prothorax quadratisch (Fig. 36), Ränder und Areolen kräftig, scharfkantig entwickelt, Randpunktierung tief und gross. Schild-

chen etwas quadratisch, am Hinterrand flach nach innen gebuchtet. Elytren mit kräftiger Gitterung von vorwiegend quadratischer Gestalt und sehr kurzer Behaarung.

Länge: 9 mm. Breite (hum.): 2 mm.

Süd Celebes: Mt. Lompobatang, 1600 m, Parasalamakki, VII.1936 (L. J. TOXOPEUS).

1 ♂. Typus in meiner Sammlung.

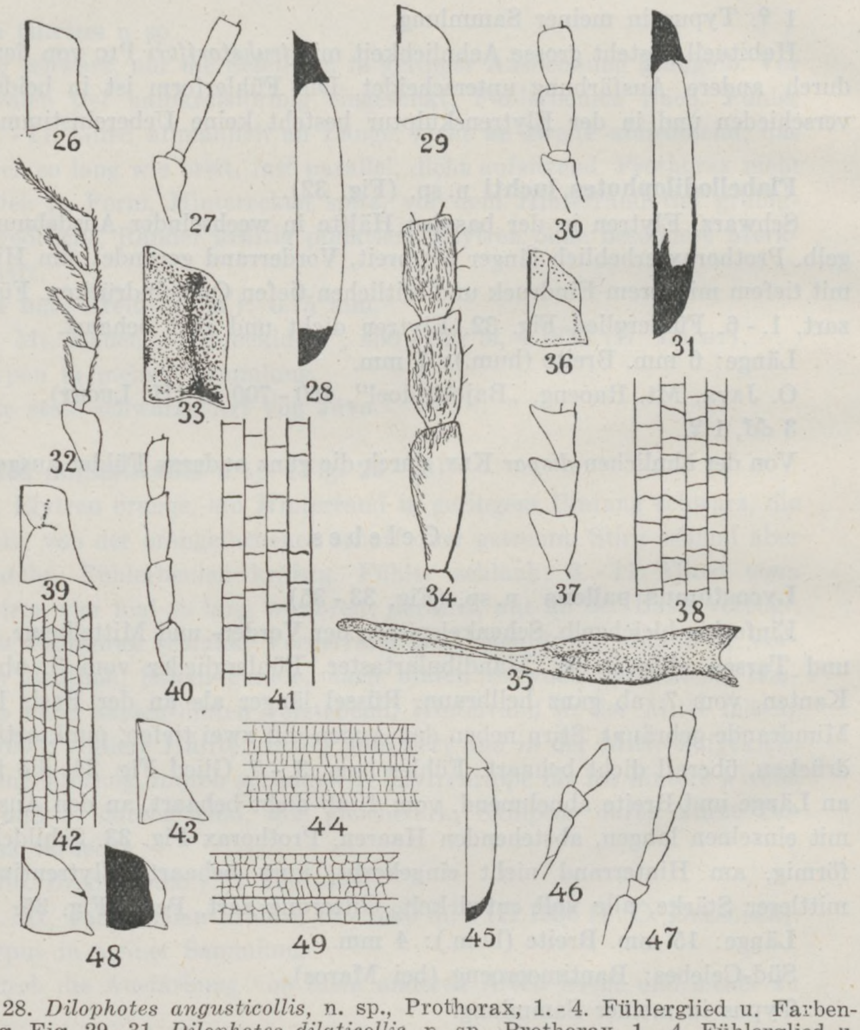

Fig. 26 - 28. *Dilophotes angusticollis*, n. sp., Prothorax, 1. - 4. Fühlerglied u. Farbenverteilung. Fig. 29 - 31. *Dilophotes dilaticollis*, n. sp., Prothorax, 1. - 4. Fühlerglied u. Farbenverteilung. Fig. 32. *Flabellodilophotes luchti*, n. sp., 1. - 6. Fühlerglied. Fig. 33 - 35. *Lycostomus pallens*, n. sp., Prothorax, 3. - 5. Fühlerglied u. Penis. Fig. 36 - 38. *Xylobanus reverens*, n. sp., Prothorax 3. - 5. Fühlerglied u. Elytrengitterung. Fig. 39 - 41. *Xylobanus ferreus*, n. sp., Prothorax, 1. - 5. Fühlerglied u. Elytrengitterung. Fig. 42. *Trichalus miserandus*, n. sp., Elytrengitterung. Fig. 43 - 45. *Leptotrichalus densereticulatus*, n. sp., Prothorax, Elytrengitterung u. Farbenverteilung. Fig. 46 - 47. *Calochromus toxopei*, n. sp., Mandibulartaster u. 1. - 5. Fühlerglied. Fig. 48 - 49. *Trichalus signatus*, n. sp., Prothorax u. Elytrengitterung.

Als einzige Art die zum Vergleich in Frage käme ist *nigricolor* PIC zu nennen. Abgesehen davon, dass sie viel weniger tiefschwarz ist, sind auch habituelle Unterschiede vorhanden. So ist der Prothorax bei beiden Arten von ganz verschiedener Gestalt und die Elytrengitterung ist bei *nigricolor* quer, wie das der Autor auch ausdrücklich angibt. Bei *reverens* ist die Gitterung quadratisch bis langrechteckig, niemals quer.

Xylobanus ferreus n. sp. (Fig. 39 - 41).

Schwarz mit stahlblauem Schimmer, schlank, glänzend, nur die Elytren und Fühler matt. Stirn breit und flach eingesenkt. Fühler schlank, 1. - 5. Glied, Fig. 40, 6. - 10. von etwa gleicher Länge, nach vorn schmaler werdend, 11. kürzer als das 10. Prothorax Fig. 39, Skulptur undeutlich. Schildchen gross, verkehrtherzförmig, Hinterrand tief eingebuchtet. Auf den Elytren sind Rippen und Gitterung kräftig entwickelt, Gitterung lang-rechteckig (Fig. 41). Beine sehr schlank.

Länge: 8 mm. Breite (hum.): 2 mm circa.

Süd Celebes: Mt. Lompobatang, 1600 m, Parasalamakki, VII.1936 (L. J. TOXOPEUS).

Typus (♀) im Museum Leiden.

Habituell und in der Ausfärbung besteht grosse Aehnlichkeit mit *reverens*. Die Unterschiede durch die Abbildungen leicht festzustellen.

Trichalus miserandus n. sp. (Fig. 42).

Abdomen und Hinterbrust schwärzlich, Vorderbrust gelbbraun, Beine schwarz mit hellen Hüften und gleichgefärbter Schenkelbasis, Kopf und Fühler schwarz, Prothorax gelbbraun, in der Mitte verdunkelt, die diskoidale Areole aber hell stehen lassend, Schildchen schwarz, Elytren graubraun, Rippen und Gitterung mehr oder weniger hell behaart. Schlank. Kopf auffallend klein. Fühler schlank, vom. 3. - 10. Glied an Länge und Breite abnehmend, selbst das 11. ist nicht so lang wie das 3., die Glieder erheblich länger als breit und nicht eigentlich gezahnt. Prothorax am Hinterrand so breit wie in der Mitte hoch, Vorderecken gerundet, Hinterecken spitz vorgezogen, Areole breit, Randpunktierung kräftig. Auf den Elytren sind Rippen und Gitterung sehr scharfkantig ausgebildet (Gitterung Fig. 42).

Länge: 10 mm. Breite (hum.): 2 mm circa.

Süd Celebes: Mt. Lompobatang, Malino, 1000 m, VI.1936 (L. J. TOXOPEUS).

1 ♂♀: Typus in meiner Sammlung.

Diese schlanke Art ist durch die Form und Ausfärbung des Prothorax und durch die ganz eigenartige Gitterungsform gekennzeichnet und kollidiert mit keiner anderen von Celebes.

Leptotrichalus densereticulatus n. sp. (Fig. 43 - 45).

Abdomen blauschwarz, Brust gelb, Beine schwarzbraun, alle Schenkel in der basalen Hälfte gelb, an den Vorderbeinen erstreckt sich die helle Färbung

bis auf die Schienen, Kopf gelb, 1. - 3. Fühlerglied, zuweilen auch noch die Basis des 4. gelb, sonst schwarz, Prothorax, Schildchen und Elytren lehmgelb, letztere nur an der äussersten Spitze geschwärzt. Fühler ohne besondere Merkmale. Prothorax gegen den Hinterrand auffallend erweitert, Areole sehr deutlich. Elytren mit sehr dichter, wenn auch etwas ungleicher Gitterung.

Länge: 14 - 15 mm. Breite (hum.): 3 mm.

Süd Celebes: Watanljita, 200 m, Bone (Watampone), 27.VI.1935 (L. E. C. VEEN); Toradja Landen, VII.1935, 700 m (A. BUSKENS).

2 ♀♀. Typus in meiner Sammlung.

Von allen bekannten Celebesarten durch die Elytrengitterung und durch die allgemeine Ausfärbung unterschieden. Am ähnlichsten sieht ihr noch *tolianus* PIC, die aber durch die einfarbigen Elytren und die gänzlich andere Elytrengitterung leicht zu unterscheiden ist. An den Celebestyp erinnert nur noch das blauschimmernde Abdomen, im übrigen ist der Gesamthabitus durchaus dem der mehr westlichen und nördlichen Arten gleich.

Ditoneces princeps n. sp.

Abdomen und Brust schwarzbraun, hochglänzend, Beine von gleicher Farbe, Hüften, Schenkel und Schienen im Basalteil gelblich, Fühler und Kopf schwarzbraun, Prothorax, Schildchen und Elytren lehmgelb, der Prothorax auf der Mitte, das Schildchen und die Sutura meist bräunlich angedunkelt; auf der ganzen Oberseite lackartig glänzend, Elytren kurz aber dicht behaart. Stirn etwa 1½ Augendurchmesser breit. Lamellen der mittleren Fühlerglieder beim ♂ so lang wie das Glied selbst, beim ♀ tiefgezahnt. Prothorax am Hinterrand so breit wie in der Mitte hoch, Vorderecken gerundet, Hinterecken rechteckig oder nur wenig spitz vorgezogen. Auf den Elytren ist die Gitterung durch dichte Behaarung stark verdeckt.

Länge: 6.5 mm. Breite (hum.): 1.5 mm circa.

Central Celebes: Todjamboe, 600 - 1000 m, bei Palopo, VII.1936 (L. J. TOXOPEUS).

Es ist der erste *Ditoneces* von Celebes und mit keiner anderen Art zu vergleichen. Die dunklen Farben auf der Oberseite des Körpers können soweit zurückgehen, dass fast Einfarbigkeit eintritt. Beachtlich ist der lackartige Glanz des ganzen Tieres.

Calochromus toxopei n. sp. (Fig. 46 - 47).

Tief stahlblau, nur die Hinterecken des Prothorax dunkelorange, am ganzen Körper glänzend. Mandibulartaster Fig. 46. Stirn mit linienförmiger Mittelrinne, sonst glatt. 1. - 5. Fühlerglied des ♂ Fig. 47, die folgenden bis zum 10. schwach gezahnt, beim ♀ sind alle Glieder kürzer, gedrungener und breiter. Prothorax quadratisch oder etwas breiter als hoch, Vorder- und Hinterecken gerundet, Mittelfurche schmal, durchgehend. Schildchen zungenförmig, kurz, am Hinterrand gerundet. Elytren mit nur schwacher Rippenbildung aber auffallend kräftiger Skulptur.

Länge: 10 - 12 mm. Breite (hum.): 2 mm.

Central Celebes: Todjamboe, 600 - 1000 m, bei Palopo, VII.1936 (L. J. TOXOPEUS, dem ich diese prachtvolle Art widme). Zahlreiche Exemplare lagen mir vor.

Ein Vergleich mit einer anderen Art dieser grossen Gattung ist nicht möglich, sie ist in der Ausfärbung so appart, dass sie ganz isoliert dasteht.

Insel Boeroe.

Trichalus signatus n. sp. (Fig. 48 - 49).

Schwarz, Beine, Unterseite des Körpers mehr oder weniger und die Fühler grau, dicht behaart, Prothorax an den Seiten gelb (Fig. 48). Fühlerglieder vom 3. ab länger als breit, kräftig gezahnt. Prothorax Fig. 48, breiter als hoch, Ränder erhöht, Areole deutlich, auch die seitlichen verhältnismässig stark ausgebildet. Schildchen breit, zungenförmig, am Hinterrand nur flach eingebuchtet. Elytrengitterung in wechselnder Gestalt, vielfach 5eckig aber auch 4eckig, in der verschiedensten Form.

Länge: 10 mm. Breite (hum.): 2 mm circa.

Boeroe (Buru) 1921, ohne nähere Angabe (L. J. TOXOPEUS).

Typus ♀, in meiner Sammlung.

Durch die Ausfärbung nur mit *luzonicus* KLN. zu vergleichen. Habituell sind sich die Arten sehr ähnlich, ebenso in der Thoraxform. Grundlegend verschieden sind bei beiden Arten die Fühler: bei *luzonicus* kurz, die Glieder gedrungen, bei *signatus* schlank, die Glieder vom 3. ab länger als breit. Die Skulptur des Prothorax ist verschieden und die Schwarzfärbung ist bei *signatus* ausgedehnter als bei *luzonicus*.

Länge: 10-12 mm. Breite (hum.): 2 mm.

Central Celebes: Tobjamboe, 600-1000 m, bei Paloepo, VII.1936 (L. J. Toxopeus, dem ich diese prachtvolle Art widme). Zahlreiche Exemplare lagen mir vor.

Ein Vergleich mit einer anderen Art dieser grossen Gattung ist nicht möglich; sie ist in der Ausfärbung so apart, dass sie ganz isoliert dasteht.

Insel Boeroe.

Trichalus signatus n. sp. (Fig. 48-49).

Schwarz. Beine, Unterseite des Körpers mehr oder weniger und die Fühler grau, dicht behaart. Prothorax an den Seiten gelb (Fig. 48). Fühlerglieder vom 2. ab länger als breit, kräftig gezahnt. Prothorax Fig. 48, breiter als hoch, Ränder erhöht, Areole deutlich, auch die seitlichen verhältnismässig stark ausgebildet. Schildchen breit, zungenförmig, am Hinterrand nur flach eingebuchtet. Elytrengitterung in wechselnder Gestalt, vielfach 5eckig aber auch 4eckig, in der verschiedensten Form.

Länge: 10 mm. Breite (hum.): 2 mm circa.

Boeroe (Buru) 1921, ohne nähere Angabe (L. J. Toxopeus).

Typus ♀, in meiner Sammlung.

Durch die Ausfärbung mit *lineatus* Kln. zu vergleichen. Habituell sind sich die Arten sehr ähnlich, ebenso in der Thoraxform. Grundlegend verschieden sind in beiden Arten die Fühler: bei *lineatus* kurz, die Glieder gedrungen, bei *signatus* schlank, die Glieder vom 3. ab länger als breit. Die Skulptur des Prothorax ist verschieden und die Schwarzfärbung ist bei *signatus* ausgedehnter als bei *lineatus*.

5. BEITRAG ZUR KENNTNIS DER INDO-MALAYISCHEN *MALACODERMATA* (COL.).

Von

W. WITTMER

(Zürich).

Die nachstehend beschriebenen Arten entstammen grösstenteils einer umfangreichen Bestimmungssendung, die ich Hernn M. A. LIEFTINCK, Entomologe am Zoologischen Museum und Laboratorium in Buitenzorg verdanke, die übrigen erhielt ich von Herrn F. C. DRESCHER, oder sie stammen aus meiner eigenen Sammlung. Die Stücke aus dem Buitenzorger Museum (Typen jetzt im Leidener Museum) sind jeweils am Schlusse der Beschreibung gekennzeichnet.

Lampyridae

Pygoluciola nov. gen.

♂ Kopf mit den Augen nur mässig weit über den Halsschildvorderrand ragend, Augen gross, stark gewölbt, fein facettiert, Stirne seicht längseingedrückt. Fühler langgestreckt, fadenförmig, fast von halber Körperlänge, am Vorderrande der Augen eingefügt. Halsschild breiter als lang, trapezförmig, ziemlich flach, Mittellinie erhaben, Basalecken etwas ausgezogen, abgerundet, Halsschildvorderrand kaum merklich über die Stirne vorgezogen, Vorderecken herabgedrückt, der Seitenrand erlöscht kurz vor den Vorderecken, Seitenflächen gegen die Vorderecken flach eingedrückt. Schildchen dreieckig mit abgerundeter Spitze. Flügeldecken langestreckt, in der Mitte am breitesten, zur Spitze leicht verschmälert, Seitenrand vorstehend, bei der Ansicht von oben sichtbar. Abdomen aus 7 Segmenten zusammengesetzt, wovon das drittletzte zu einem Leuchtorgan umgebildet ist, das 6. bezw. vorletzte, ist tief halbkreisförmig ausgeschnitten, die Seiten des letzten Sternites umfassen das 6. vollständig, die Spitze des letzten Sternites ist spatelförmig ausgezogen (erscheint stumpf) und leicht nach oben gebogen, die Spitze wird durch das viel längere, stielförmige nach unten gebogene, letzte Tergit verdeckt. Das letzte Tergit ist zur Spitze schwach verbreitert und in der Mitte leicht ausgerandet.

♀ in der Körperform dem ♂ sehr ähnlich, der Halsschild ist seitlich gegen den Vorderrand weniger stark abgeflacht eingedrückt, weder das letzte Tergit noch das letzte Sternit sind stielförmig verlängert, nur das vorletzte Sternit ist in der Mitte bis zur Hälfte seiner Länge tief ausgerandet, wodurch das letzte, zur Spitze kaum merklich ausgerandete Sternit stark verlängert erscheint.

Der Habitus ist der einer *Luciola,* die eigentümlichen, an die primitiveren Formen der Gattung *Malthodes* erinnernde Bildung der Analsegmente, lässt sie nicht mit Lucida verwechseln. Von den übrigen ebenfalls durch besondere Bildung des Abdomens ausgezeichnete Gattungen der *Luciolini* unterscheidet sie sich wie folgt:

Tabelle der ♂

1. Spitze der Flügeldecken auf die Unterseite gegen das Abdomen gebogen. Letztes Segment verhältnismässig kurz, Spitze breit, verdickt, mit ein oder zwei mehr oder weniger tiefen Eindrücken versehen ... *Pteroptyx* E. OLIV.
— Spitze der Flügeldecken normal ausgebildet. Letztes Segment nicht klobig verdickt, mit halbkreisförmigen Lamellen, spitzen gegabelten Anhängen oder spatel- bezw. stielförmigen Fortsätzen versehen 2
2. Ausser dem letzten Sternit ist auch das letzte Tergit besonders ausgebildet und zwar in einen langen, nach unten gebogenen, zur Spitze schwach verbreiterten und leicht ausgerandeten Stiel ausgezogen. *Pygoluciola* nov. gen.
— Nur das letzte Sternit besonders ausgebildet, das Analtergit ist normal, manchmal mehr oder weniger tief ausgerandet 3
3. Letztes Abdominalsegment in der Mitte mit einem scharfkantigen, gabelförmig gespaltenen, nach oben gebogener und das Pygidium umfassenden Fortsatz verlängt .... *Colophotia* MOTSCH.
— Letztes Abdominalsegment in der Mitte mit einem kurzen dreieckigen Lobus, daneben jederseits eine halbkreisförmige (ohrenförmige), stark behaarte, etwas ausgehöhlte Lamelle, die seitlich an der Basis durch einen mehr oder weniger langen, gekrümmten, ziemlich spitzen Fortsatz bedeckt wird. *Pyrophanes* E. OLIV.

Pygoluciola stylifer nov. spec.

Schmutziggelb bis braungelb, Kopf schwarz, Augen dunkelbraun, Fühler und äusserster Vorderrand des Halsschildes dunkel gefärbt, manchmal auch die Vordertibien und alle Tarsen mehr oder weniger angedunkelt.

Kopf breiter als lang, schwach, zerstreut punktiert, fein behaart. Fühler langgestreckt, fast von halber Körperlänge, 1. Glied ziemlich stark verdickt, ungefähr um die Hälfte länger als das 2., 3. Glied fast um die Hälfte länger als das 2., 4. - 10. jedes ungefähr so lang wie das 3., 11. nur wenig länger als das 10., Behaarung kurz, mit vereinzelten längeren, schräg abstehenden Haaren. Halsschild ziemlich stark punktiert, auf den Seiten und gegen die Basalecken stärker, fast narbenartig. Schildchen fast glatt, nur mit feinen Haarpunkten besetzt. Flügeldecken ziemlich tief und regelmässig, fast in Reihen punktiert, mit Spuren von 2 - 3 Längsrippen.

Länge 10,5 - 11 mm.

Fundort: M.O.-Borneo Expedition, Long Petah, 450 m, IX-X.1925 (leg. H. C. SIEBERS).

Type in coll. Rijksmuseum Leiden.

Drilidae

Brachypterodrilus nigripes nov. spec.

♂ Schwarz, nur der Halsschild rotbraun, mit einer breiten medianen Makel, die die ganze Länge einnimmt, an der Basis und an den Seiten verblasst, bezw. schlecht begrenzt ist, Kniegelenke leicht aufgehellt.

Kopf breiter als lang, mit den Augen nur wenig schmäler als der Halsschild, Stirne fast flach, jederseits mit einem seichten Eindrucke, der zwischen den Augen, in der Mitte Stirne beginnt und schräg neben Fühlergrube und Vorderrand des Auges, gegen die Wangen, verläuft. Punktierung zerstreut, grob und tief. Behaarung dunkel. Fühler etwas länger als der halbe Körper, 2. Glied kurz, etwas breiter als lang, vom 3. Gliede an sind die Fühler leicht zusammengedrückt, bis zum 10. grob gezähnt, 3. nur wenig länger als breit, schwach gezähnt, 4. um $\frac{1}{4}$ länger als das 3., 5. bis 10. von leicht abnehmender Länge, jedes ungefähr so lang wie breit, 11. langgestreckt, nicht ganz doppelt so lang wie das 10. Halsschild etwas breiter als lang, in der Mitte am breitesten, beidseitig, jedoch nach vorne nur unmerklich stärker als zur Basis, verengt, Basalecken deutlich, schwach stumpfwinklig, Basis jederseits neben den Vorderecken etwas eingedrückt, Längsfurche besonders an der Basis deutlich, Punktierung grob und tief, an der Basis und an den Seiten etwas stärker und dichter als auf der Scheibe, Behaarung gelblich. Schildchen dreieckig, stark punktiert. Flügeldecken mehr als doppelt so lang wie breit, etwas verkürzt, die Flügel nur zu $^4/_5$ bedeckend, zur Spitze verschmälert, klaffend, runzlig gewirkt, Seiten, Spitzen und ein apikaler Teil der Naht fein gerandet, mit punktförmigen, wenig deutlichen Vertiefungen an den Seiten zur Spitze dicht neben dem Rande.

Länge: 4 - 4,5 mm.

Fundort: Java (Type in meiner Sammlung).

Von *B. pallidipes* PIC durch dunklere Färbung und anscheinend etwas robustere Gestalt verschieden.

Mimophaeopterus wittmeri ab. **maculata** nov.

Mit der Stammform bis auf die Färbung der Flügeldecken übereinstimmend, letztere sind anstatt einfarbig gelblich, an den Spitzen mit einer schmalen dunkelbraunen Makel versehen.

Fundort: W. Java, Preanger (Priangan), G. Tangkoeban Prahoe, 13 - 1700 m (leg. F. C. DRESCHER).

Falsophrixothrix flavus nov. spec.

♂ Gelb, Fühler, Augen, die hautigen Flügel, Unterseite und Beine schwarzbraun.

Kopf mit den Augen schmäler als der Halsschild, etwas breiter als lang, leicht gewölbt, ziemlich dicht mit narbenartigen Haarpunkten besetzt, Haare

lang, Augen etwas hervortretend. Fühler die Schultern um weniges überragend, vom 3. Gliede an jederseits mit einer langen, schmalen und nach aussen gebogenen Lamelle versehen (fächerförmig), die an der Basis des Gliedes entspringt, woselbst das Glied leicht verdickt ist; die Lamellen des 3. Gliedes sind kurz, ungefähr so lang wie das Verbindungsglied, vom 4. bis 11. Gliede sind Lamellen ungefähr von gleicher Länge, bedeutend länger als das Stammglied, 11. Glied etwas länger als das 10., 2. Glied knötchenförmig. Besonders die Spitzen der Lamellen sind mit einzelnen langen Haaren besetzt. Halsschild fast doppelt so breit wie lang, schmäler als die Flügeldecken, schwach gewölbt, Vorderecken etwas herabgedrückt, Seiten im vorderen Drittel am breitesten, zum Vorderrande stärker gerundet verengt als zur Basis, kurz vor den Basalecken schwach ausgerandet (abgeflacht), sodass diese fast rechtwinklig hervortreten, Basalrand vor den Basalecken jederseits schwach eingedrückt, Oberfläche ähnlich wie beim Kopfe mit narbenartigen, etwas niedrigeren Haarpunkten besetzt. Flügeldecken ca $2\frac{1}{4}$ mal so lang wie an den Schultern breit, leicht klaffend, etwas verkürzt, nur etwa $^{3}/_{5}$ der totalen Länge der Flügel bedeckend. Enden der Decken zugespitzt, Seitenrand gegen die Spitzen breiter werdend und mit dem apikalen Teil der Naht, wulstartig verdickt. Decken mit unregelmässigen, groben Runzeln, an der Basis undeutlich punktiert, gegen die Spitze mit einzelnen tieferen und gröberen Punkten; eine deutliche Rippe ist erkennbar, die gegen die Spitze an der Naht von der wulstartigen Verdickung abzweigt und schräg über die Flügeldecken sich fast bis zu den Schulterbeulen erstreckt, Behaarung ziemlich lang.

Länge: 5,5 - 6 mm.

Fundort: W. Java, Preanger (Priangan), G. Tangkoeban Prahoe, Type in meiner, Cotype in Sammlung F. C. Drescher.

Grösser als die bisher von Java beschriebenen Arten, durch die gelbe Färbung der Oberseite ausgezeichnet, bei *F. pygmaeus* E. Oliv. und *javanus* Pic sind die Flügeldecken dunkel; bei *humeralis* Pic ist der ganze Körper dunkel, bis auf die Schultern, die beiden ersten Fühlerglieder und die Beine, die bei *humeralis* Pic gelb sind.

Cantharidae

Laemoglyptus lieftincki nov. spec.

♂ Einfarbig rotbraun, Halsschild und Beine etwas blasser braun gefärbt, Augen schwarz.

Kopf mit den Augen etwas schmäler als der Halsschild. Augen stark hervortretend, deren Durchmesser ist grösser als der Abstand der Fühlergruben, Behaarung weisslichgelb. Fühler kaum länger als der halbe Körper, vom 3. Gliede an stark gekämmt, Lamellen flach, schwach ausgehöhlt, Lamellen der Mittelglieder ungefähr doppelt so lang wie das Stammglied. Halsschild fast so breit wie die Flügeldecken, doppelt so breit wie lang, Vorderecken verrundet, Seitenrand in der Mitte verdickt und mit einem gegen die Schultern gerichteten

Einschnitt versehen, Basis stark verengt (eingeschnürt), Basalecken schwach hervortretend. Flügeldecken langestreckt, Punktierung unkenntlich, Längsrippen fehlen, Behaarung ziemlich dicht, gelblich.

Länge: 4,5 mm.

Fundort: W. Java, Tjiliwoeng Est., Telaga Saät, 1400 m, 9.8.1931, leg. M. A. LIEFTINCK (Type in coll. Rijksmuseum Leiden).

Von den übrigen bisher beschriebenen Arten durch die blassbraune Färbung leicht zu unterscheiden.

Es freut mich diese Art dem verdienstvollen Erforscher der indo-malayischen Fauna, Herrn M. A. LIEFTINCK, zu widmen.

Laemoglyptus (*Silis* olim) **longipennis** PIC.

Diese Art wurde in der Zeitschrift „L'Echange" 26, 1910, p. 70, nach einem ♀ beschrieben. Das ♀ eines mir vorliegenden Paares mit Fundort G. Papandajan (W. Java, Priangan), 23.9.1934, leg. Dr. L. J. TOXOPEUS, stimmt vollkommen mit der Beschreibung PIC's überein. Ich bin deshalb in der Lage nachstehend das ♂ bekanntzugeben.

Schwarz, Halsschild orangerot mit schwarzer, medianer, zur Basis verbreiterter Makel, die weder den Vorder- noch den Basalrand erreicht, Flügeldecken einfarbig braun, glänzend, Tibien dunkel, mehr oder weniger aufgehellt.

Kopf schmäler als der Halsschild, mit den schwach hervortretenden Augen, deren Abstand fast doppelt so gross wie der Durchmesser eines Auges ist, fast doppelt so breit wie lang. Fühler kürzer als der halbe Körper, vom 3. Gliede an gleichmässig und stark gekämmt. Halsschild breiter als lang, vorne halbkreisförmig verrundet, in der Basalhälfte am breitesten, hier verdickt und mit einem Einschnitt versehen, Aussenrand des Einschnittes in eine stumpfe Ecke auslaufend, Innenrand spitz, kurz vor der Basis ist der Halsschild rechtwinklig eingeschnürt, die Basalecken angedeutet. Scheibe mit weniger deutlicher medianer Längsfurche und zwei schwachen Beulen jederseits neben dem Schildchen, glatt, Behaarung fein. Schildchen braun, etwas dunkler als die Flügeldecken gefärbt. Flügeldecken fast 4 mal so lang wie an den Schultern breit, zur Spitze nur wenig verbreitert. Punktierung verworren, Basis und Spitzen fast glatt, Behaarung kurz, wenig dicht, gelblich.

Laemoglyptus longispinus nov. spec.

♂ Einfarbig schwarz, nur die Klauen leicht aufgehellt.

Kopf mit den Augen schmäler als der Halsschild, Augen verhältnismässig klein, deren Abstand etwas mehr als 2 mal so gross wie der Durchmesser eines Auges. Fühler länger als der halbe Körper, vom 3. Gliede an gekämmt. Halsschild etwas breiter als lang, kurz vor der Mitte am breitesten, Seitenrand an dieser Stelle zahnartig ausgezogen, die Seiten des Zahnes sind mit einem schmalen Einschnitte versehen, Basalecken stark, halbkreisförmig ausgeschnitten, Basis in einen langen Dorn ausgezogen, Seiten- und Basalzahn ungefähr von gleicher Länge. Scheibe des Halsschildes mit deutlicher Längsfurche und zwei

schwachen Basalhöckern jederseits von dem Schildchen. Flügeldecken mehr als 3 mal so lang wie an den Schultern breit, fast parallel, runzlig skulptiert, Behaarung kurz, gelblichweiss.

Länge: 6,5 - 7 mm.

Fundort: N. Sumatra, Atjeh, Mt. Leuser, Febr. 1937, leg. A. HOOGERWERF (Type in Rijksmuseum Leiden, Cotype in meiner Sammlung).

Mit *Laemoglyptus* (*Silis* olim) *kannegieteri* PIC verwandt, Gestalt grösser, die beiden langen Dorne an den Halsschildseiten fehlen bei *kannegieteri* PIC, sie zeichnen die neue Art gut aus.

Discodon padangum PIC.

(Mélanges exotico-entomolgiques 33, 1921, p. 23).

Die Beschreibung PIC's passt ziemlich gut auf die mir vorliegenden Tiere. Nachstehend lasse ich die Beschreibung, die aufgrund von Exemplaren mit Fundort Enggano I., 5/7.1936 (leg. Dr. J. K. DE JONG) erstellt ist, folgen:

Gelbbraun, Kopf, Fühler, Schildchen, die äusserste Spitze der Schenkel, alle Tibien und Tarsen, schwarz, Flügeldecken grün metallisch.

Kopf mit den Augen schmäler als der Halsschild, fast so lang wie breit, äusserst fein, am Clypeus etwas stärker punktiert. Fühler etwas länger als der halbe Körper, 2. Glied fast um ⅓ kürzer als das 3., 3. um ⅓ kürzer als das 4., 4. bis 10. unter sich von gleicher Länge, 11. eine Spur länger als das 10. Halsschild breiter als lang, fast rechteckig, nach vorne nur leicht verengt, alle Ränder etwas aufgeworfen, Seitenränder stärker als der Basal- und Vorderrand, jederseits an der Basis und in der Mitte an den Seitenrändern mit einer seichten grubenartigen Vertiefung versehen. Behaarung doppelt, fein gelblich anliegend, auf der Scheibe mit schräg aufgerichteten, längeren und dickeren, schwarzen, borstenartigen Haaren untermischt. Flügeldecken ca 3 mal so lang wie breit, an den Schultern nur wenig breiter als der Halsschild, im ersten Drittel der Länge leicht verbreitert erscheinend, indem die Seiten nicht bauchseits gebogen sind wie auf der restlichen Länge. Decken zur Spitze leicht klaffend, runzlig gewirkt, matt, nur die Basis fast glatt, glänzend, Behaarung doppelt, fast senkrecht abstehend, länger, schwarz und anliegend, kurz, greis.

Themus gracilipes nov. spec.

Dunkelgrün metallisch, Clypeus, Wangen, Fühler, ein Saum rund um den Halsschild, der auf den Seiten am schmälsten ist, Beine und Unterseite teilweise, rotbraun. Die Spitzen der Schenkel, die Tibien und Tarsen stellenweise mit mehr oder weniger starkem Metallglanze. Schildchen dunkel mit der Tendenz zur Aufhellung an der Basis.

Kopf etwas breiter als lang, Augen ziemlich stark hervortretend, deren Durchmesser etwas grösser als die Länge der Wangen. Stirne ziemlich stark und dicht punktiert, gegen den Clypeus zerstreuter, letzterer wieder stärker punktiert, Haare weisslich, ziemlich lang. Fühler kürzer als der halbe Körper,

fadenförmig, 2. Glied eine Spur länger als das 3., 4. und folgende um $\frac{1}{4}$ länger als das 2. Halsschild quadratisch, schmäler als der Kopf mit den Augen, Seiten fast gerade, sehr schwach ausgebuchtet, nur Basis gerandet, Scheibe fast glatt und glänzend mit Haarpunkten, deren Abstand das mehrfache des Durchmessers ausmacht. Flügeldecken ca 4 mal so lang wie an den Schultern breit, klaffend, von der Mitte ab der Länge nach gerollt, verworren, dicht punktiert, die Punkte durch erhabene Runzeln miteinander verbunden, zwei Längsrippen andeutend. Beine schlank, verhältnismässig lang.

Länge: 19 mm.

Fundort: Mt. Kinabalu, Kubambang (Br. N. Borneo) 12.8.1933, 4000 Fuss (leg. J. Clemens).

Type in Sammlung Rijksmuseum Leiden.

Mit *Th. kasianus* Gorh. verwandt, mit dem die neue Art in der Färbung grosse Aehnlichkeit besitzt, der Kopf ist jedoch bei *gracilipes* in grösserer Ausdehnung metallisch, der Halsschild fast länger als breit, die Flügeldecken unregelmässiger gerunzelt punktiert, nur die Spitze der Hinterschenkel dunkel, die Episternen der Vorderbrust, die Hinterbrust und das Abdomen mit dunkeln, grünmetallischen Makeln versehen. Bei *Th. kasianus* Gorh. ist der Kopf von den Augen an gelb gefärbt, der Halsschild deutlich breiter als lang, die Flügeldecken regelmässig runzlig gewirkt, matt, die Spitzen aller Schenkel metallisch und die Unterseite ist einfarbig gelb.

Tylocerus brunneus nov. spec.

♂ Dunkelbraun, Behaarung gelblich, Mandibeln und Seitenrand der Flügeldecken rötlich durchscheinend. Bauchsegmente braun, gelb gesäumt, Basalsegmente mit gelber Mittellinie.

Kopf mit den stark hervortretenden Augen etwas schmäler als der Halsschild, Punktierung fein und regelmässig. Fühler länger als der halbe Körper, 2. und 3. Glied verkürzt, unter sich von gleicher Länge, jedes fast halb so lang wie das 1., 4. um die Hälfte länger als das 3., 5. nur wenig länger als das 4., 6. bis 10. jedes so lang wie das 5., 11. eine Spur länger als das 10. Halsschild um die Hälfte breiter als lang, Ränder, besonders an den Seiten aufgebogen, alle Ecken verrundet, Seiten nach vorne schwach verengt, Basalhälfte mit zwei angedeuteten Längsbeulen vor dem Schildchen, Punktierung fein, dicht und regelmässig. Flügeldecken ca $3\frac{1}{2}$ mal so lang wie an den Schultern breit, hier nur wenig breiter als der Halsschild, gegen die Spitzen leicht erweitert, matt, verschwommen punktiert. Spitze der äusseren Klauen gespalten.

Länge: 14 - 15 mm.

Fundort: N. Neu Guinea Expedition 1926, Mamberamo Fluss, Explorat.-Bivak ± 700 m (leg. W. Docters van Leeuwen). Type in Sammlung Rijksmuseum Leiden.

Von allen mir bekannten Arten der Gattung *Tylocerus* durch einfarbig dunkelbraune Gestalt, die langgestreckten Fühlerglieder und die Grösse verschieden.

Malachiidae

Carphurus strictiplicatus nov. spec.

Schwarzbraun, Mandibeln (ausser der Spitze) und 4 - 5 Basalglieder der Fühler, gelb. Spitzen der Tibien, besonders der Vordertibien etwas aufgehellt.

Kopf breiter als lang, mit den Augen etwas breiter als der Halsschild, Stirne leicht gewölbt, zwischen den Augen fast glatt, fein behaart, mit kaum wahrnehmbaren Haarpunkten, Schläfen und Scheitel mit feinen Querrunzeln versehen. Fühler die Schulterbeulen etwas überragend, 3. Glied eine Spur länger als das 2., bis zum 10. von gleicher Länge, 11. nur wenig länger als das 10., mit abgerundeter Spitze, 3. bis 10. Glied auf der Innenseite, besonders gegen die Spitze, leicht erweitert-verdickt. Halsschild ungefähr so lang wie breit, Seiten kurz vor der Basis eingeschnürt, Basis deutlich gerandet, auf den Seiten nach dem ersten Drittel erlöschend, vordere Hälfte stärker gewölbt als die Basis, diese seicht quer eingedrückt, vorderes Drittel mit feinen vereinzelten Punkten (Haarpunkten) dann anschliessend mit Querrunzeln versehen, die schwach gebogen verlaufen, die mittleren deuten gegen die Vorderecken, ohne diese jedoch zu berühren, an der Basis sind die Runzeln mit einer Anzahl deutlicher, ziemlich tiefer Punkte untermischt. Flügeldecken etwas mehr als doppelt so lang wie an den Schultern breit, zur Spitze nur wenig verbreitert, jede Decke einzeln abgerundet, äusserst fein chagrinartig skulptiert, 4 letzte Tergite unbedeckt, Behaarung kurz, greis.

Länge: 3,5 mm.

Fundort: O. Java, Idjen Plateau, Blawan, 950 m, 1.6.1924 (leg. K. W. DAMMERMAN). Type im Rijksmuseum Leiden, Cotype in meiner Sammlung.

Diese Art ist charakterisiert durch das Fehlen jeglichen deutlichen Eindruckes am Kopfe (es befinden sich bloss zwei seichte, längliche Depressionen jederseits neben der Fühlerbasis) und den mit deutlichen Querrunzeln versehen Halsschild (⅔ des Schildes bedeckend). *Carphurus plicaticollis* PIC und *C. rastratus* CHAMP. besitzen ebenfalls einen quergerunzelten Halsschild, der Kopf ist jedoch bei beiden Arten mit 2 oder 4 runden, narbenartigen Vertiefungen versehen, ausserdem weichen die Tiere durch die Färbung von *strictiplicatus* m. ab; *plicaticollis* PIC hat roten Kopf und Halsschild, schwarze Flügeldecken, manchmal mit metallischem Glanze; *rastratus* CHAMP. hat ähnliche Färbung, die Flügeldecken weisen ausgesprochen metallischen Glanz auf.

Carphurus nitidicollis nov. spec.

Pechfarben, 3 - 5 Basalglieder der Fühler und Vorderschienen mehr oder weniger aufgehellt.

Kopf breiter als lang, Augen ziemlich stark hervortretend, Stirne glatt, nur auf der vorderen Kopfhälfte gegen den Clypeus mit zwei seichten Längseindrücken, Behaarung kurz, fein und spärlich, über jedem Auge befindet sich eine längere Borste. Fühler länger als der halbe Körper, 2. Glied etwas kürzer als das 3., bei der Ansicht von oben so breit wie dieses, nach unten leicht verbreitert

und von vorne gesehen, so breit wie das leicht verdickte erste Glied, breiter als das 3., 3. bis 10. ungefähr von gleicher Länge, perlschnurförmig, die Endglieder zur Spitze etwas dicker als die Basalglieder, 11. so lang wie das 10. mit stumpfer Spitze. Halsschild ungefähr so lang wie breit, Seiten zur Basis schwach verengt, gerandet, vor der Basis quer eingedrückt, glatt, fein und kurz behaart, mit einer längeren Borste in den Basalecken. Flügeldecken etwas mehr als doppelt so lang wie an den Schultern breit, zur Spitze nur wenig verbreitert, jede Decke einzeln abgerundet, chagrinartig skulptiert, matt, Behaarung weisslichgrau, kurz, ziemlich dicht, 3 - 4 letzte Tergite unbedeckt.

Länge: 2,2 - 2,5 mm.

Fundort: S. Java, Noesa Kambangan, 1 - 5.12.1925 (leg. F. C. DRESCHER).

Verwandt mit *C. enganoensis* CHAMP. von der sie sich durch den Kopf und den Halsschild unterscheidet, die bei der neuen Art glatt, währenddem sie bei *enganoensis* CHAMP. fein punktiert sind.

Carphuroides preangerensis nov. spec.

Schwarz, 2 - 3 Basalglieder der Fühler, Clypeus, Mundteile, Halsschild, dritt- und viertletztes Tergit rot gefärbt, Flügeldecken mit blaugrünem Metallglanze.

Kopf breiter als lang, mit den normal grossen Augen so breit wie der Halsschild, mit einem „V"-förmigen Eindrucke auf der vorderen Kopfhälfte, dessen Schenkel den Clypeus fast erreichen, die Basis des Eindruckes ist mit der Stirne durch eine seichte Längsfurche verbunden, Scheibe zerstreut, am Rande der Augen stärker, Schläfen runzlig punktiert. Die Fühler reichen nur wenig über die Schulterbeulen, 2. Glied so lang wie das 3., zur Spitze leicht knotig verdickt, 3. leicht gezähnt, 4. und folgende eher etwas kürzer als das 3., stark gezähnt, 5. so lang wie breit, vom 6. bis 10. etwas breiter als lang, 11. verdickt. Halsschild kaum breiter als lang, Seiten in der vorderen Hälfte fast parallel, Basaldecken mit der basalen Hälfte und der Basis fast halbkreisförmig verrundet, Vorderecken ebenfalls, jedoch nicht so stark verrundet, vollständig glatt, nur an der Basis gegenüber den Schulterbeulen, nahe dem Aussenrande, befindet sich jederseits eine ziemlich lange, fast senkrecht aufstehende Borste. Flügeldecken fast doppelt so lang wie an den Schultern breit, stark grünlich oder bläulich metallisch glänzend, besonders im vorderen Drittel fast glatt, die vier letzten Hinterleibsegmente sind unbedeckt.

Länge: 3,8 - 5 mm.

Fundort: W. Java, Preanger (Priangan), G. Tangkoeban Prahoe, Mai 1934 (leg. F. C. DRESCHER).

Ein weiteres Exemplar lag mir aus der Sammlung des Zool. Mus. Buitenzorg vor (etwas defekt, die Fühler fehlten), dessen Mittelschienen etwas aufgehellt sind und dessen Flügeldecken einen violetten Metallglanz aufweisen. Der Kopf ist etwas stärker punktiert.

Von den übrigen Arten der Gattung *Carphuroides* unterscheidet sie sich durch den einfarbig roten Halsschild. In der Fühlerbildung hat sie einige Aehn-

lichkeit mit *C. dentiger* CHAMP., bei *preangerensis* ist das 2. und 3. Glied von fast gleicher Länge und das 4. Glied weist schon dieselbe starke Zähnung auf wie die folgenden Glieder; bei *dentiger* CHAMP. ist das 2. Glied kürzer als das 3. und die Zähnung beginnt erst vom 5. Gliede an.

Neocarphurus basirugosus nov. spec.

Schwarz, Oberlippe und 4 - 5 Basalglieder gelb oder gelblich, 1. Glied auf der Oberseite leicht angedunkelt, Spitze der Schenkel und Spitze der Vordertibien mehr oder weniger rötlich (durchscheinend).

Kopf etwas breiter als lang, mit den Augen kaum breiter als der Halsschild, matt, chagrinartig gerunzelt, über jedem Fühler grubenartig, seicht eingedrückt, Schläfen quergerunzelt. Fühler von halber Körperlänge, fadenförmig, 1. Glied ziemlich stark verdickt, fast doppelt so dick wie das 2. Glied, 2. etwas kürzer als das 3., 4. fast doppelt so lang wie das 2., um $\frac{1}{4}$ länger als das 3., 4. bis 10. von gleicher Länge, 11. etwas länger und dicker als das 10. Halsschild länger als breit, Seiten zuerst fast parallel, dann bis zu $\frac{3}{4}$ der Länge gegen die Basis stark bogenförmig verengt, eingeschnürt, basales Viertel wieder mit parallelen Seiten, dieser Teil ist stark aufgebogen und durch eine quere Furche vom vorderen Teil des Halsschildes getrennt, Basis fein gerandet, mit feinen Längsstricheln bis zu Beginn der Querfurche, Seiten der Querfurche mit einigen Querstricheln versehen, Rest des Halsschildes glatt, glänzend, teilweise äusserst fein mikroskulptiert. Flügeldecken doppelt so lang wie breit, zur Spitze schwach verbreitert, abgestutzt, matt, fein chagriniert, spärlich behaart, 4 - 5 letzte Tergite unbedeckt.

Länge: 2,8 - 3,2 mm.

Fundort: O. Java, Idjen Plateau, Blawan, 900 - 1500 m, November 1934 (leg. H. LUCHT).

Verwandt mit *N. annulipes* CHAMP., durch dunklere Färbung, durch die Bildung des Kopfes, der nur über der Fühlerbasis einen Eindruck aufweist und den Halsschild, der an der Basis mit feinen Längsstricheln und an den Seiten der Querfurche mit Querstricheln versehen ist, verschieden. Bei *annulipes* CHAMP. ist der Kopf „V"-förmig eingedrückt, die Basis des Halsschildes glatt, nur die Seiten gegen die Vorderecken mit Längsstricheln markiert.

Telocarphurus nov. gen.

♂ Kopf etwas breiter als lang, mit grossen stark hervortretenden Augen, deren Durchmesser grösser als die Länge der Schläfen. Fühler neben dem Vorderrande der Augen eingefügt, den Clypeus fast berührend, Abstand der Fühlerwurzeln etwas kürzer als die Länge des ersten Fühlergliedes. Fühler länger als der halbe Körper, Glieder langgestreckt, zur Spitze leicht verdickt, mit langen, fast senkrecht abstehenden Haaren besetzt, die Haare sind so lang oder länger als die dazugehörigen Fühlerglieder. Halsschild bedeutend schmäler als der Kopf, ungefähr so lang wie breit, Seiten parallel, nur kurz vor der Basis unmerklich

verengt, Seitenränder von oben nicht ersichtlich, sie werden durch die stark gegen die Unterseite abgebogenen Seiten verdeckt, Basis leicht erhaben, fein gerandet, die Randung erlischt auf den Seiten kurz nach der Basis; glatt, glänzend, mit vereinzelten Haarpunkten. Flügeldecken ca 2 mal so lang wie an den Schultern breit, leicht klaffend, zur Spitze einzeln abgerundet und etwas verschmälert. Die hautigen Flügel überragen manchmal die Decken um weniges. Die 4 Analtergite unbedeckt. Beine und Tarsen schlank, die kammartige Bürste am ersten Glied der Vordertarsen klein, schwach ausgebildet.

♀ Die Augen sind bedeutend kleiner, deren Durchmesser kleiner als die Länge der Schläfen. Fühler kürzer, die langen abstehenden Haare fehlen. Erstes Glied der Vordertarsen einfach. Form des Halsschildes und der Flügeldecken ungefähr wie beim ♂.

Verwandt mit *Carphuromorphus* PIC, die schmale Gestalt, die grossen Augen, die langen, mit langen Haaren besetzten Fühler, die stark gewölbten, parallelen Seiten des Halsschildes, an dessen Basis der Quereindruck fehlt, sind Merkmale, die die Gattung hinlänglich von *Carphuromorphus* und den übrigen *Carphurini* trennt.

Telocarphurus drescheri nov. spec.

♂ Schwarz, nur die beiden ersten Fühlerglieder orangegelb gefärbt, Mundteile leicht aufgehellt.

Kopf auf der unteren Hälfte zwischen den Augen und dem Clypeus mit zwei Längseindrücken versehen, diese sind an ihren Enden durch ein gemeinsames Längsstrichel, das die Mitte der Stirne fast erreicht, verbunden, die eingedrückten Stellen etwas dichter punktiert, matt, Scheibe grob, ziemlich dicht punktiert, Scheitel runzlig gewirkt, schwach ausgeprägt quer verlaufend, Schläfen mit deutlichen, feinen Querrunzeln.

Jederseits sind um die Augen 3 - 5 mehr oder weniger lange, borstenartige Haare verteilt. Fühler länger als der halbe Körper, 1. Glied zur Spitze verdickt, ziemlich lang, fast so lang wie das 2. und 3. zusammen, 2. Glied knötchenförmig, etwas länger als breit, 3. bis 7. von gleicher Länge, 8. bis 10. unter sich gleich lang, eine Spur länger als das 7., 3. bis 10. jedes zur Spitze leicht verdickt, 11. spindelförmig um $1/4$ länger als das 10. Halsschild glatt und glänzend mit vereinzelten Haarpunkten, die Haare auf den Seiten reichlicher als auf der Scheibe. Flügeldecken an den Schultern so breit wie der Kopf mit den Augen, stark glänzend, fast metallisch, Punktierung undeutlich, verworren, Haare kürzer als die des Halsschildes. Erstes Tarsenglied am grössten, 2. bis 4. von abnehmender Grösse. Klauenglied der Vordertarsen fast doppelt so lang wie das verkürzte 1. Glied, bei den Mittel- und Hintertarsen nur wenig länger als das 1. Glied. Abdomen büschelförmig mit längeren Haaren besetzt.

♀ Augen von normaler Grösse, Halsschild kurz vor der Basis leicht verengt, etwas deutlicher als beim ♂, 1. Glied der Vordertarsen einfach. Die Fühler erreichen die Schulterbeulen, 2. und 3. Glied von gleicher Länge, 4. bis 10. unter

sich von fast gleicher Länge, jedes zur Spitze etwas verdickt, 11. um ¼ länger als das 10. Die längeren Haare an den Fühlern fehlen, sie sind fast anliegend mit kürzeren Haaren besetzt, die Behaarung des übrigen Körpers ist spärlicher als beim ♂.

Länge: 3,2 - 3,7 mm.

Fundort: W. Java, Preanger (Priangan), G. Tangkoeban Prahoe, 13 - 1600 m, Mai und Juli 1937 (leg. F. C. DRESCHER). Die Art ist ihrem Entdecker gewidmet.

ON A NEW SPECIES OF *CHILOMYCTERUS* FROM NEW GUINEA.

By

L. F. DE BEAUFORT

(Zoological Museum, Amsterdam).

Dr. Hardenberg kindly sent me for identification a species of *Chilomycterus*, collected by him in December 1937 at Merauke, South New Guinea. The specimen turned out to belong to an undescribed species, which I have the pleasure to call after its discoverer:

Chilomycterus hardenbergi n. sp.

D.1.10. A.1.10. P.1.17.1. C.9.

All measurements given below are in millimeters. Length without caudal 128; height 43; head 51, height of head 38, breadth of head at gillopening 46. Eye without free orbital margin, 12, situated in the middle of the length of the head and 6 above the horizontal through corner of mouth. Interorbital 34. Spines short but strong, compressed, each with three very strong, long, flat ridged roots. A small spine in front and somewhat above each nostrill, which is best described as a round, open tube with a round perforation anteriorly at its base. Two supraorbital spines on each side; the inner roots of the anterior pair almost touch each other in the median line. Snout, forehead, and interorbital space smooth, without median spines. Only six spines in a longitudinal median series between head and origin of dorsal. Seven spines in the longitudinal row to the right and the left of the median one, the last of these spines connected with each other through their inner roots, immedialtely behind the dorsal. Two spines to the right and the left of the end of the anal are connected through their inner roots behind the anal in the same way as those at the end of the dorsal, the lower roots of which are connected with the upper roots of the former, forming a bony ring round the anterior part of the caudal peduncle, which is otherwise smooth. Back and belly completely covered by spines, those of the back with longer and broader roots than the others. The body is surrounded by 17 spines behind the head and with 9 spines in front of the dorsal and the anal. Dorsal, anal, and caudal rounded, narrow at their bases and expanding distally. Length of base of dorsal and anal 10, of caudal 7. Longest dorsal ray 27, longest anal ray 25, longest caudal ray 44. Length of caudal peduncle 16, its height anteriorly 20. Pectorals in the form of a trapesium; the length of their base 14, of the hindborder 40, of the outer rays 25. Colour of the preserved specimen crimson,

lighter below. The spines of the back dark towards their end. Fins reddish, dorsal, anal, and caudal dusky at tip. Length of the specimen described 172.

This species is allied to *Ch. affinis* GHTR. As in this species forehead and the interorbital space are without spines, but it differs in having less rays in the fins and in having only six spines in a longitudinal series along the median line of the back. Besides the coloration is different.

A NEW MEMBRACID FROM WEST JAVA.

By

W. D. FUNKHOUSER

(University of Kentucky, Lexington).

In a collection of *Membracidae* recently received by the writer for determination, through the courtesy of Mr. M. A. LIEFTINCK of the Zoological Museum of Buitenzorg, Java, is a new species which is here described and figured as follows:

Xiphistes maculipennis sp. nov. (Fig. 1).

Yellow with front of head, front of metopidium and suprahumerals dark brown; finely punctate, sparingly pubescent; suprahumerals projecting directly outward; posterior process reaching just beyond internal angles of tegmina; tegmina yellowish brown with a conspicuous dark brown spot in the center; undersurface and legs yellow, red markings on clypeus and sides of metopidium.

Technical description:

Head subquadrate, twice as wide as high, dark brown, roughly sculptured, finely punctate, densely pubescent, base arcuate; eyes light brown; ocelli large, conspicuous, glassy, equidistant from each other and from the eyes and situated about on a line drawn through centers of eyes; clypeus bright red, twice as long as broad, subquadrate, base broadly emarginate, tip truncate, clypeus extending for two-thirds its length below lateral margins of genae; lateral margins of genae convex, edged with yellow.

Pronotum yellow, finely punctate, sparingly pubescent; metopidium convex, wider than high, decorated with a large round dark brown spot in center and a smooth bright red fossa above each eye; humeral angles heavy, triangular, blunt, extending outward slightly farther than the eyes; median carina strongly percurrent; suprahumeral horns short, heavy, triangular, extending directly outward and not at all upward or forward, as long as the distance between their bases, upper surface flat and nodulate, lower surface ridged, tip acute; posterior process straight, yellow, punctate, tectiform, gradually acuminate, tip sharp and extending just beyond internal angles of tegmina; scutellum narrowly exposed on each side.

Fig. 1. *Xiphistes maculipennis*, sp. nov.

Tegmina long, narrow, lanceolate, pointed; yellow, opaque, slightly pubescent, with a large dark brown circular spot in center; base narrowly coriaceous, light brown; three apical and five discoidal cells; apical veins slightly curved; no apical limbus.

Sides of thorax and undersurface of body light yellow; femora light brown; tibiae somewhat flattened and foliaceous, yellow; tarsi dark brown.

Length from front of head to tips of tegmina 6.4 mm.

Width between tips of suprahumeral horns 3.5 mm.

Type: male.

Type locality: Depok, West Java, 100 m alt.

Described from a single specimen taken at the type locality by M. A. LIEFTINCK on November 25, 1933. Type in author's collection.

This species may be at once recognized by the large brown spot on the tegmina and by the brilliant red markings on the metopidium and the clypeus.

HISPINEN VON JAVA
AUS DER SAMMLUNG DES HERRN F. C. DRESCHER.

78. Beitrag zur Kenntnis der Hispinen (Col. Chrys.)

(Mit 1 Textfigur).

Von

E. UHMANN
(Stollberg-Erzgeb.).

Herr DRESCHER sandte mir in den Jahren 1935 - 1938 wiederum seine Ausbeuten zur Bearbeitung zu. Sie sind für die Kenntnis der Hispinen-Fauna Javas ausserordentlich aufschlussreich. Zugleich erhielt ich von ihm Angaben über die Beschaffenheit der einzelnen Sammel-Oertlichkeiten, worüber ich kurz berichte. Wenn nichts Besonderes erwähnt wird, gilt Herr DRESCHER als Sammler. Die Holotypen wurden mir wieder in liebenswürdiger Weise überlassen, Paratypen in beiden Sammlungen.

Abkürzungen der vorkommenden Fundorte.

Residentschaft Banjoemas, Mittel-Java.

BGS Batoerraden, Goenoeng Slamat. Urwald, 800 - 1000 m.

GS Goenoeng Slamat.

NK Noesa Kambangan. Eine Insel ganz nahe der Südküste Javas bei Tjilatjap. Fundstellen im Urwald (Naturschutzgebiet), 10 - 150 m.

Bergland von Preanger (Priangan) in West Java.

PB Preanger, Bandoeng. Um Bandoeng ist die Hochebene ohne Wald, von Reisfeldern bedeckt.

PTP Preanger, G. Tangkoeban Prahoe. Fundstellen im Urwald in einer Höhe von 1400 m aufwärts.

PR Preanger, Radjamandala. Thee- und Gummiplantage nebst Urwald, 400 m.

PD Preanger, Djampangs, Goenoeng Tjisoeroe. Landstrich südlich von Soekaboemi. Fundstellen im Urwald, 600 - 700 m hoch.

Neue Gattung.

Klitispa, abgetrennt von *Agonia*.

Neue Arten.

Anisodera suturella. *Callispa bioculata*. *Wallaceana costata*. *Agonia undata* UH., früher ab. von *spathoglottis*.

Bekannte Arten neu für Java.

Gonophora (*Micrispa*) *bouchardi* GEST. *Dactylispa oberthüri* GEST.

Nummern meiner hier aufgeführten Beiträge.

14. Zeitschr. wiss. Insbiol. 24.1929.
18. Zool. Meded. Leiden 13.1930.
44. Bull. Mus. Roy. Hist. Nat. Belg. 10.1934.

Der vorhergehende Beitrag über Ausbeuten DRESCHER's war: 53. Treubia, 15.1935 p. 141 - 150.

1. **Anisodera suturella** n. sp. — Elongata, brunnea, elytris nitidis, prothorace latitudine perparum longiore, fortiter subcrebre punctato, lateribus parallelis, elytris apice singulatim rotundatis, dente parvo suturali, costa humerali ante medium bifurcata, interdum bifurcatione obliterata. 12 - 15 mm.

Unterscheidet sich von den von mir zu *A. lucidiventris* GUÉR. gestellten Stücken vor allem durch glänzende Decken, schlankere Fühler, deren Glieder 3 - 5 länger sind, Glied 3 dreimal so lang wie breit, 4 - 5, jedes doppelt so lang wie breit (vergl. 18. p. 85). Bei *A. lucidiventris* ist Glied 3 doppelt so lang wie breit und 4 - 5, jedes anderthalbmal so lang wie breit. Toment $^5/_3$, das 3. Glied bei *A. suturella* an der Spitze unten dichter behaart. Auch die Glieder 6 - 10 sind länger als die von *A. lucidiventris*, jedes doppelt so lang wie breit. — Halsschild wie bei *A. lucidiventris*. — Decken an der Spitze einzeln breit abgerundet, mit kleinem Nahtzähnchen. Rippen ziemlich gut entwickelt, die 1. nur an der Naht undeutlich, die 2. an der Basis schwach, die 3. (Schulterrippe) vollständig, kurz vor der Mitte bei fast allen Stücken gegabelt und die entstandene Zweigrippe zwischen der 2. und 3. Rippe meist vollständig. Naht und Seitenrand zuweilen schmal schwarz.

♂: Letztes Sternit eben, doppelt punktiert, behaart. Hinterrand sehr seicht ausgebuchtet.

♀: Letztes Sternit dicht punktiert und behaart, mit nach oben ansteigender breit-dreieckiger Fläche, sein Hinterrand gerade abgeschnitten.

Holotypus und Allotypus: Preanger (P. F. SIJTHOFF), ebendaher ein Paratypus, diese Stücke in meiner Sammlung. 1 Paratypus: Ost-Java, 1890, in coll. KRAATZ im Deutschen Entom. Institut Berlin-Dahlem. 1 Paratypus: Preanger: Patoeawattie, 2000 m, 30.V.35 (L. J. TOXOPEUS) in coll. DRESCHER, ferner 18 ♂, 10 ♀ PTP, alles Paratypen, in coll. DRESCHER und der meinigen.

2. **Callispa bioculata** n. sp. — Ovata, nitida, flavo-testacea, antennis articulis basalibus exceptis nigris, elytris rufo-testaceis, utroque elytro in dimidio apicali macula violacea. — Antennis gracilibus; prothorace transverso, convexo, lateribus subrectis, disco irregulariter punctato, angulis anticis rotundatis, protecto deficiente, juxta marginem lateralem et apicalem serie punctorum tenuorum. 3,3 mm.

Neben *C. pusilla* GEST. zu stellen, aber die Spitzenhälfte der Decken nicht ganz schwarz, sondern nur mit schwarzem Fleck; Punktur der Oberseite feiner,

Decken gerundeter. — Hell gelbbraun, Fühler ohne die beiden Basalglieder schwarz, bei 2 Stück geht die Färbung mehr ins Bräunliche. Decken mehr rötlichbraun, jede hinter der Mitte mit einem unscharf begrenzten, blaumetallischen Fleck. — Stirn glatt, äusserst fein punktiert, Fühler schlank. Halsschild doppelt so breit wie lang, fast rechteckig, bis zum sehr fein gerandetem Seitenrand gewölbt, auf der Scheibe unbestimmt eingedrückt, Vorderecken ganz verrundet. Schildchen fast quadratisch. Decken mit Punktreihen, die zur Spitze feiner werden, ohne Seitendach, am Rande mit sehr feiner Punktreihe.

4, Java: Preanger, G. Tangkoeban Prahoe, 1300 - 1700 m, V.VII.VIII.1937 (F. C. Drescher).

3. Oncocephala tuberculata Ol. — Die javanischen Stücke kann ich nur mit Vorbehalt zu dieser Art stellen. Sie stimmen mit den vorhandenen Beschreibungen überein, was allerdings nicht viel besagen will. Ostindische Stücke liegen mir leider nicht vor. 1, Preanger, Djampang Tengah (M. E. Walsh); 4, Süd-Preanger, Patimoean; 1, Süd-Banjoemas, Djeroeklegi.

4. Wallaceana costata n. sp. — Elongata, nitida, flavo-testacea, antennis nigris articulo primo fusco, elytris dimidio apicali nigris sutura fere usque ad scutum nigrata. — Antennis gracilibus, articulo tertio longo; elytris interstitiis costatis, apice singulatim rotundatis. 5,2 - 5,8 mm.

Neben *W. apicalis* Gest. zu stellen, unterscheidet sich von ihr sofort durch die auf allen Zwischenräumen gerippten Decken und die schlanken Fühler. — Glänzend gelbbraun, Fühler ohne das rotbraune 1. Glied schwarz, fast die ganze Spitzenhälfte der Decken und die Naht bis ans Basalfünftel schwarz, Deckenspitze bisweilen rotbraun durchscheinend. — Stirnschwiele breit, fein und nicht dicht punktiert. — Fühler schlank, Glied 1 - 4 glänzend, Glied 5 - 11 etwas breiter als die vorhergehenden, matt, pubeszent, Glied 1 ellipsoidisch, 2 ebenso lang, gestreckt, 3 länger, konisch, doppelt so lang wie breit, 4 kurz, die folgenden zylindrisch, wenig voneinander verschieden, jedes etwa so lang wie 2, Endglied länger. — Halsschild quer mit schwach gerundeten Seiten, Vorderecken verrundet mit schwach angedeuteten Vorderwinkeln, Hinterwinkel spitz vorgezogen, Seitenrand schmal, Hinterrand durch eine scharfe Querlinie gerandet, Scheibe zerstreut und unregelmässig punktiert. — Decken zur Spitze etwas verbreitert, nicht so parallel wie bei den anderen *Wallaceana*-Arten, an der Spitze einzeln abgerundet, mit kleinem Nahtzähnchen. Alle Zwischenräume von der Basis ab konvex-gerippt, hinter der Mitte 9 Räume, der 4. verbindet sich mit dem 6. am Abfall, der 5. daher dort verkürzt, der 6. und 7. vereinigen sich in der Mitte und bilden nach vorn die Schulterrippe. Seitenrand abgesetzt, an der Spitze etwas breiter.

♂: Letztes Sternit tief ausgerandet. ♀: Dieses abgestutzt, kaum ausgerandet. 8 ♂, 5 ♀, BGS. II.-IV.1937.

4b. Wallaceana costata n. sp. **ab.** 1 ♂. — BGS. Decken gelbbraun, an der Spitze nur äusserst schwach getrübt.

5. Wallaceana apicalis GEST. **ab.** — Decken einfarbig gelbbraun. An A r e n - palm. 4 ♂, 4 ♀ PB. 750 m, 19.VII.36.

♂: Hinterrand des letzten Sternites ausgerandet. 5⅓ mm.

♀: Letztes Sternit abgerundet-abgestutzt, mit schwach flachgedrückter Halbkreis-Fläche, fast geradeaus gestreckt. 5⅔ - 6⅓ mm. Diese einfarbigen Stücke stelle ich zu *W. apicalis* GEST. Sie stimmen mit einem normal gefärbten Stück meiner Sammlung überein.

6. Wallaceana marginata GEST. — 2 ♂, 1 ♀ PTP; 1 ♀ O. Java, Blawan, 900 - 1500 m, Idjen Plateau (H. LUCHT).

♂: Letztes Sternit ausgerandet.

♀: Letztes Sternit abgestutzt, mit halbkreisförmiger, flachgedrückter Fläche, die etwas dorsalwärts gerichtet ist.

Bei den vorliegenden Stücken erweitert sich beim ♂ die schwarze Seitenbinde zur Spitze, sodass diese ganz schwarz wird, beim ♀ bleibt die Spitze gelbbraun, davor vereinigen sich die beiden schwarzen Seitenstreifen.

Freund MAULIK überliess mir einen Paratypus seiner *W. chunia* aus Java (Ann. Mag. Nat. Hist. 20.1937. p. 238). Er gleicht dem ♀ der *W. marginata.*

6a. Wallaceana marginata GEST. **ab.** — Bei dieser Aberration sind die Decken fast ganz gelbbraun, sodass man das Vorkommen dieser Art mit ganz gelbbraunen Decken annehmen kann. 1, Java, Res. Banjoemas: Koebangkangkoeng, 1.V.27.

6b. Wallaceana-Arten. — Die Seitenstücke der Vorderbrust haben bei den hier erwähnten und vielleicht bei fast allen *Wallaceana*-Arten hinter der Einlenkung der Vorderbeine einen mehr oder weniger deutlichen, spitzigen Zahn.

7. Downesia bambusae MLK. (Entomologist, 66.1933. p. 90). — 2 ♂, Buitenzorg, 250 m (L. G. E. KALSHOVEN). Vorderschienen mit 1 Zahn an der Spitze.

8. Agonia undata UH. — 5 ♂, 5 ♀. Preanger, G. Pantjalikan, Radjamandala, 400 m, 29.VI.35 (L. J. TOXOPEUS), Paratypen. In 14. p. 149 stellte ich diese Art als Varietät zu *A. spathoglottis* UH. Das neuere Material zeigt aber, dass wir es mit einer guten Art zu tun haben. Zu den in l.c. angeführten Unterschieden kommen noch folgende hinzu: 3. Fühlerglied auffallend lang, länger als 1 + 2. Halsschild schmal abgesetzt. Seitenrand der Decken nicht gerade, sondern gebuchtet, das eine Mal in einem sehr stumpfen Winkel hinter der Schulter, zum andern in einer sehr sanften Schwingung hinter der Mitte, sodass der mittlere Teil des Seitenrandes stärker hervortritt. Hinterrand der Decken stärker gezähnelt. 2. Streif vorn mit Punkten einer 4. Zusatzreihe. Geschlechtsunterschiede wie bei *A. spathoglottis.* Mittelschienen beim ♂ an Basis und Spitze stärker erweitert als beim ♀. Neu für Java.

Klitispa n. g. — Differt ab *Agonia* WS. ungue solo, obliquo.

Diese neue Gattung, deren Arten bisher zu *Agonia* gestellt wurden, sind dieser sehr ähnlich und ihr sehr nahe verwandt. Die Arten von *Klitispa* haben nur eine Klaue, die andere ist nicht entwickelt. Die Klaue befindet sich nicht in der Mitte

der Klauengliedspitze, sondern sie ist schief nach aussen gewendet. Bei den Beinen der rechten Seite ist nur die rechte, bei denen der linken Seite nur die linke Klaue entwickelt. Hierher gehören: *A. opacula* SPAETH und *corrugata* SP. (Stylops, 2.1933. p. 272), ferner *opacicollis* GEST. und *nigripennis* WS.

9. **Klitispa opacula** SPAETH (Fig. 1). — Bei einer hellen Aberration ist der Halsschild ganz gelbbraun, ebenso die Decken, bei diesen ist schwarz: Der schmale Rand des 4. Streifens, die Hinterhälfte des 3. Streifens nebst der Apikalhälfte der beiden ihn einschliessenden Rippen, vom 2. Streifen das Stück auf dem Abfall und vor ihm in der hinteren Deckenhälfte ein schwarzes Fleckchen, das mit dem Schwarz des 3. Streifens in Verbindung steht, 1. Rippe nur auf dem Abfall dunkel, Naht in der Apikalhälfte angedunkelt (siehe Figur). — Die schwarze Apikalfärbung ist zuweilen noch mehr reduziert, sodass die gelbe Färbung hinten bis auf den 3. Streif reicht. Stücke mit fast parallelen Decken sind wahrscheinlich die ♂♂, solche, bei denen die Decken etwas nach hinten erweitert sind, wären dann die ♀♀. — 3, Preanger: Djampang, 600 - 700 m (M. E. WALSH).

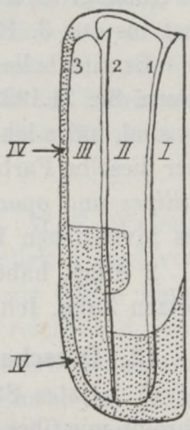

Fig. 1. *Klitispa opacula* SPAETH. Zeichnung auf der linken Decke. I - IV: Zwischenstreifen. 1 - 3: Rippen. Punktiert: schwarz.

10. **Gonophora (Micrispa) bouchardi** GEST. — Eine farbveränderliche Art. Jede Decke mit 3 gelben Flecken, die sich vergrössern können, sodass die beiden basalen zu einem gemeinsamen Fleck verschmelzen und die vor der Spitze eine Querbinde bilden. Der Mittelfleck letzterer erweitert sich entlang der 2. Rippe nach der Basis zu, in zwei Fällen verschmilzt er mit dem gemeinsamen Basalfleck. In diesem Falle sind auch die Flecke vor der Spitze zu einer Querbinde verbunden. Diese beiden Stücke stellen die hellste bisher bekannte Farbaberration dar (2 Stück, PTP). — Halsschild ganz schwarz (4), meist vorn beiderseite der Mittelschwiele mit rötlichem Fleck, der sich allmählich vergrössert, bis die ganze Vorderhälfte nebst Seiten hell wird. Bei einem Stück ist fast der ganze Halsschild rötlichgelbbraun. — GESTRO schreibt, der 2. Zwischenstreif habe 4 Punktreihen. Ich kann nur 3 zählen. Die Unterbrechung der 1. Rippe hinter der Basis ist verschieden stark und deutlich. Neu für Java. 36, PTP. Weiteres Material von GS (1); Goenoeng Goentoer (2); BGS (6); NK (1), bei diesem Stück ist die schwarze und gelbbraune Färbung fast gleichmässig verteilt, Beine heller.

♂: Der Fortsatz in der Verlängerung der Mittelschienen vorhanden, aber nicht so spitz und deutlich wie bei *M. sinuata* GEST.

11. **Gonophora (Micrispa) sinuata** GEST. — 1, BGS. IV.1937. Dieses Stück stimmt gut mit der Beschreibung überein, ist aber nur 3 mm lang und vor dem Abfall ist auf der 1. Rippe nur ein kleiner Fleck hell. — 2, Djeroeklegi, Süd-Banjoemas, 9.VII.1935: Dunkle Stücke. Decken dunkelbraun bis schwarz, hellbraun sind: 3 Flecke auf der 1. Rippe; 2 auf der 2. Rippe, vor und hinter

der Mitte, mit den letzten beiden Flecken der 1. Rippe abwechselnd; 2 Flecken auf der 3. Rippe mit denen der 2. Rippe gleichliegend und verbunden; der erweiterte Seitenrand. — 2 Stück BGS. XII.1936 und 1, GS. IV.1925 stelle ich ebenfalls zu dieser Art. Sie sind aber viel heller gefärbt, bei ihnen haben sich die hellen Flecke auf den Decken so vergrössert, dass sie zusammenhängen und bei dem einen überwiegt dann die gelbbraune Färbung. — 1, PTP hat einen schwarzen Halsschild. — Bei 1, PTP sind die vorderen beiden Deckenflecken zu einem grossen Fleck verschmolzen, der längs bis zur Deckenmitte und seitlich fast bis zur 3. Rippe reicht. Der Fleck vorm Abfall ist auch vergrössert.

Es gibt helle Stücke, die mit der Beschreibung der *M. javana* Ws., Philipp. Journ. Sc. 21.1922. p. 77 übereinstimmen. Da keine skulpturellen Unterschiede da sind, halte ich die *M. javana* für eine helle Aberration von *sinuata*. Es liegt hier dieselbe Farbveränderlichkeit vor, die man bei *M. bouchardi* GEST., *Klitispa pallipes* und *opacula* SPAETH (Stylops, 2.1933. p. 271, 273) und anderen Arten des javanischen Faunengebietes beobachten kann.

2 Stück haben als Fortsetzung der Mittelschienen an deren Spitze einen spitzen Zahn. Ich halte sie für die ♂♂.

12. Drescheria reinecki Ws. — 3 ♂, 2 ♀, PTP, an Bambus.

♂: Letztes Sternit tief ausgerandet. ♀: Dieses abgestutzt. Herr DRESCHER schreibt mir über diese Art: Ich habe diese Art in grosser Anzahl an Bambus-Büschen gefangen. Das erste Mal fand ich das Tier am Goenoeng Merbaboe in Anzahl an einer *Solanacea* mit weissen Blüten, ähnlich dem Dornapfel, in einer Höhe von etwa 1300 m, ... und jetzt zum dritten Male in sehr grosser Anzahl an Bambusbüschen in einer Höhe von 1400 m am G. Tangkoeban Prahoe an einer Stelle, wo ich seit 1928 das ganze Jahr hindurch sammeln lasse.

13. Hispellinus moestus BALY. — 20 Stück von verschiedenen Fundorten. Wahrscheinlich ist es eine andere Art, die von der ostindischen durch den Fühlerbau verschieden ist.

♂: Fühlerglied 2 - 4 rundlich, 3 am kleinsten, 4 zuweilen etwas gestreckt, 5 und 6 deutlich gestreckt, einander fast gleich. — ♀: Glied 2 rundlich, 3 und 4 deutlich gestreckt, einander fast gleich, 5 und 6 ebenfalls deutlich gestreckt, 5 grösser als die Nachbarglieder.

14. Dactylispa vethi GEST. — 5 PTP. Bei einem Stück sind die Decken innen braun, auch der Seitenrand ist breiter braun. 23 PTP. Halsschild einfarbig gelbbraun oder mit 2 mehr oder weniger deutlichen schwarzen Flecken. Randdornen der Decken schwarz.

15. Dactylispa brunnipes MOTSCH. — 6, BGS. 1, NK. 1, PR. Alle Stücke aus Java, die ich bisher zu *D. xanthospila* GEST. gestellt habe, halte ich jetzt für *brunnipes*.

16. Dactylispa oberthüri GEST. — 1, PD, Goenoeng Malang, 700 m, XII. 34 (M. E. WALSH). Neu für Java.

17. Hispa alternata CHAP. — 21, PTP. Zu dieser Art hatte ich 44. p. 5 *H. megacantha* GEST. als synonym gestellt. Das ist vielleicht nicht richtig. GESTRO schreibt Ann. Mus. Stor. Nat. Gen. 30. 1890. p. 249: thorace...disco...obsolete pubescente" und „con riflessi bronzati negli elitri, che sono molto splendenti". Beides stimmt nicht für *alternata*. MAULIK's Angabe in Fauna Br. India, 1919. p. 252, dass *megacantha* auch auf Java vorkomme, glaube ich auf *alternata* beziehen zu müssen. *H. muricata* GEST. ist als Aberration zu *alternata* zu stellen. Ich habe ein Stück, auf das seine Angabe „le antenne nei primi sei articoli, ed i piedi, sono di un nero tendente al rosso" zutrifft. Wahrscheinlich nur unausgefärbt. — WEISE führt in seinen Katalogen bei *H. muricata* noch an: *quadrifida* var. CHAPUIS, Ann. Soc. Ent. Belg. p. 52 (1877). Ich habe das Stück aus dem Brüssler Museum gesehen. Es ist bezettelt: Zanzibar, Inthia. Es ist eine *Chrysispa* sp. mit rotbraunen Beinen.

18. Platypria echinogale GEST. — 3, Süd-Bantam, 1934 (M. E. WALSH). Was ich aus Sumatra und Java zu dieser Art stelle, gehört vielleicht zwei verschiedenen Arten an. Die eine hat sehr dünne Fühler, die zur Spitze kaum verdickt sind, 7. Glied über doppelt so lang wie breit, 8. Glied reichlich doppelt so lang wie breit, 9. doppelt so lang wie 8. Alle Rippen schwach erhaben; wahrscheinlich die echte *P. echinogale*. Die andere Art hat etwas mehr zur Spitze verdickte Fühler mit kürzeren Gliedern 7 - 9, Glied 7 nicht viel länger als 8. Alle Rippen der Decken stärker erhaben. — Da aber die angegebenen Unterschiede bei den einzelnen Stücken schwanken, so lässt sich vorläufig keine einwandfreie Trennung der Arten vornehmen.

17. **Hispa alternata** Chap. — 22, ETP. Zu dieser Art hatte ich 44, p. 5 *H. megacantha* Gest. als synonym gestellt. Das ist vielleicht nicht richtig. Gestro schreibt Ann. Mus. Stor. Nat. Gen. 30 (1890) p. 249: ,,nonnè... disco obsolete pubescente" und ,,sui fianchi hanno i peli bianchi, che sono molto splendenti." Beides stimmt nicht für *alternata*. Maulik's Angabe in Fauna Br. India, 1919, p. 252, dass *megacantha* auch auf Java vorkommen, glaube ich auf *alternata* beziehen zu müssen. *H. oxiacantha* Gest. ist als Aberration zu *alternata* zu stellen. Ich habe ein Stück, auf das seine Angabe ,,le antenne coi primi sei articoli ed i piedi, sono di un nero tendente al rosso" zutrifft. Wahrscheinlich nur unausgefärbt. — Weise führt in seinem Katalog bei *H. aenescens* noch an: *quadrifida* var. Chapuis, Ann. Soc. Ent. Belg. 20, 52 (1877). Ich habe das Stück aus dem Brüsseler Museum gesehen. Es ist bezettelt: Zanzibar, Indien. Es ist eine *Chrysispa* sp. mit schwarzen Beinen.

18. **Platypria echinogale** Gest. — 2, Süd-Bantam, 1934 (M. E. Walsh). Was ich aus Sumatra und Java zu dieser Art stelle, gehört vielleicht zwei verschiedenen Arten an. Die eine hat sehr dünne Fühler, die zur Spitze kaum verdickt sind, 7. Glied über doppelt so lang wie breit, 8. Glied reichlich doppelt so lang wie breit, 9. doppelt so lang wie 8. Alle Rippen schwach erhaben, wahrscheinlich die echte *P. echinogale*. Die andere Art hat etwas mehr zur Spitze verdickte Fühler mit kürzeren Gliedern, 7.—9. Glied 9. nicht viel länger als 8. Alle Rippen der Decken stärker erhaben. — Da aber die angegebenen Unterschiede bei den einzelnen Stücken schwanken, so lässt sich vorläufig keine einwandfreie Trennung der Arten vornehmen.

ON THE TRUE POSITION OF THE GENUS *OROLESTES* McLACH.,

with notes on *O. wallacei* (Kirby), its habits and life-history (Odon., Lestid.).

By

M. A. LIEFTINCK

(Zoölogisch Museum, Buitenzorg).

The main purpose of this paper is to give a description of the hitherto unknown larva of *Orolestes*, and to prove that the genus should be considered a true member of the family *Lestidae*, a conclusion arrived at from a study of the larva, or nymph. This paper embodies also the results of some observations on the synonymy and geographical distribution of *Orolestes wallacei* in Malaysia, preceded by a description of the living insect and followed by notes on its habits and dwelling-places.

So far as the habits and life-history of *Orolestes wallacei* are concerned, my observations were carried out only during a few morning-hours of two successive days. Hence many points of dispute, more specifically those relative to the development and hatching of the egg, and the duration of larval life, are still unknown and can only be cleared up by spending a great deal of time in careful observation. I have therefore merely attempted to put down accurately the few observations I made, and to draw the correct conclusions from them.

Orolestes wallacei (Kirby).

1889. Kirby, P. Z. S. London, p. 302 - 303. — ♀ Borneo, Sarawak (*Lestes*).
1890. Kirby, Cat. Odon. p. 162 (*Lestes*).
1898. Krüger, Stett. Ent. Ztg. 59, p. 127 - 130. — ♂ N. E. Sumatra (*O. udeana*).
1902. Laidlaw, P. Z. S. London, p. 92. — ♂ def. Malaya (*Lestes ridleyi*).
1920. Laidlaw, P. Z. S. London, p. 341. — ♂ def. Borneo, Sarawak (*Lestes* spec.).
1920. Laidlaw, Rec. Ind. Mus. 19, p. 149 fig. 1 (♂ wings). — ♂ Borneo, Sarawak (*Lestes* spec.).
1927. Ris, Zoöl. Meded. Leiden, 10, p. 11 - 15, comp. notes, fig. 4 (♀ wings), 5 (♂ apps.), 6 (♀ valves). — ♂♀ C. Sumatra (*O. udeana*).
1928. Laidlaw, P. Z. S. London, p. 134 - 135 (incl. key), 138 (note). — ♂ Malaya and Borneo, notes.
1931. Laidlaw, J. Fed. Mal. States Mus. 16, p. 184 (♀), 246 (♂). — ♀ Pahang, Malaya, ♂ N. Borneo.
1933. Fraser, Rec. Ind. Mus. 35, p. 176 (key, *wallacei* + *udeana*), 177 - 178 fig. 1D (penis), 2 (♂ apps.), pl. 4 fig. 1 (♂ wings ? Borneo). — Sumatra (non vidi), Sarawak and Brit. N. Borneo (*O. wallacei* + *udeana*).
1935. Lieftinck, Misc. Zool. Sum. 92 - 93, p. 5 - 6 (note on synonymy). — Perak, Malaya, and S. Sumatra.

Material studied: 49 ♂, 12 ♀. — MALAY PENINSULA. 1 ♂ (semiad.), Perak, Kwala Kangsar, ROLLE vdt., "*Lestes magnus* Foerster, *Udeanus* Krüger Rasse *magnus* ♂ Type" (in FÖRSTER's hand), Mus. Ann. Arbor. — 3 ♂, 2 ♀ (ad.), Perak, Kwala Kangsar, B. JACHAN vend., Mus. Hamburg and author's collection.

BILLITON I. 13 ♂, 4 ♀ (ad.), Tandjong Pandan, 1.IX - 6.X.1936, 18.I.1937; 1 ♂, Banten, 21.VIII.1936; all F. J. KUIPER, Mus. Buitenzorg.

SUMATRA. Eastcoast Gvt.: 1 ♂ (ad.), Serdang, Tandjong Morawa, Dr. B. HAGEN, Mus. Leiden; 1 ♂ (ad.), id., Deli, Saentis Estate, 10.X.1936, L. J. TOXOPEUS, Mus. Buitenzorg. — Lampoeng Res.: 2 ♂ (ad.), Mt. Tanggamoes, Gisting, 500 m, 26.IX.1933 and 28.XII.1934, L. J. TOXOPEUS & AUTHOR, Mus. Buitenzorg.

JAVA (West). Buitenzorg Res.: 9 ♂, 5 ♀ (ad.), Oedjoeng Genteng (south-coast), 27 - 29.III.1937, AUTHOR, Mus. Buitenzorg. — Priangan Res.: 14 ♂, 1 ♀ (ad.), Tjidamar (south-coast), Tjisindang and Tjidaoen near Sempoertjondong, 23.X and 5 - 8.XI.1935, M. BARTELS, Mus. Buitenzorg.

BORNEO. 1 ♂ (ad.), Sarawak, Mt. Mulud, coll. SHARPE, acq. 1903, Mus. Leiden. — 3 ♂ (ad.), E. Borneo, Sangkoelirang, Kariorang, V-VI.1937, M. E. WALSH, Mus. Buitenzorg.

All specimens of *Orolestes wallacei* in Museum-collections are entirely discoloured; and since the available colour-descriptions in the literature have been made from slightly immature specimens or from those in which the dark colouring of the body is doubtless due to the effects of decomposition, it seems worth while to give a description of the living insect.

Additional description of the full-coloured imago.

Male (ad., Java, Sumatra, Billiton). — Labium yellow, rear of the head pale yellowish-green. Genae, mandible-bases, anteclypeus and labrum throughout bright greenish-blue, the labrum usually clear blue. Remaining parts of the head dull bronzy blackish-brown with metallic-green reflections on the vertex. A light brown spot in the depression just anterior to the median ocellus and two similar spots, one on each side of the lateral ocelli. Postoccipital lobes mottled with brown and yellow, fading to yellow rearwards. Antennae dark brown. Eyes olive-green intermingled with blue dorsally, shading to pale yellowish-green ventrally.

Prothorax greenish-yellow with bronzy-brown dorsal marks.

Synthorax with the dark areas dull bronzy-brown (adulti), or metallic-green with bronzy reflections (semiadulti). A narrow, dull olive-green stripe over the mid-dorsal carina and complete juxta-humeral stripes of the same colour. These shoulder-stripes are twice broader than the mid-dorsal stripe and are widest ventrally. Metepisternum and lower portion of mesinfraepisternites vivid bluish-green; most of the metepimerum and metinfraepisternites light green turning to greenish-yellow ventrally; beneath yellow.

Coxae greenish-yellow. Legs pale brown, flexor surfaces and apices of all femora ill-defined blackish-brown.

Abdomen dark blackish-brown or black with slight bronzy reflections. Segm. 2 - 4 and occasionally 5 with a fine mid-dorsal longitudinal yellow line (incomplete on both ends of the segment). Sides of 1 - 2, narrow basal rings of 3 - 7 (usually incomplete above on 5 - 7), and lower tergal margins of 3 - 7 bright bluish-green. Segm. 8, 9 and 10, with the exception of a very narrow line bordering the posterior margin of 8 - 10 and the lower margin of 9, throughout bright azure blue.

Anal appendages black. Superior pair shaped as described and figured by KRÜGER and RIS. Inferior appendages distinctly shorter than half the length of the superiors, either closely apposed or well-separated (*cf.* RIS, loc. cit. fig. 5; in the topotypical example from N.E. Sumatra of *"udeana"*, the inferior appendages are apposed!).

Wings either entirely hyaline, or with the apices, from the middle of the pterostigma outwards, very palely enfumed (semiadulti and part of the adulti); in old males the entire wing-membrane has a yellowish- or rather more greyish-brown tinge, very similar in appearance to the wings of old females of *Gynacantha*. Pterostigma dark reddish-brown, covering 3 to 5½ cells, braced. Number of postnodal cross-veins very variable: $\frac{18-24}{16-24}$ (Java), $\frac{16-19}{14-18}$ (Billiton), $\frac{17-20}{13-17}$ (Sumatra), $\frac{18-21}{16-20}$ (Borneo). A very excellent photograph of the wings of *O. wallacei* has been published by FRASER (*loc. cit.*).

F e m a l e (ad., Java, Billiton). — Under surfaces of head as in the male. Mouth-parts green instead of blue. Remaining parts of the head reddish- to dark-brown with a metallic-green trapezoidal spot on the vertex, sometimes obliterated so as to form three more or less separate spots, and with a dark metallic-green area on each side of the antennae bordering the eye-margin. Antennae with the two basal joints light brown, apex of second joint and flagellum blackish.

Prothorax yellowish, dorsum indistinctly spotted with brown.

Synthorax as in the male but all blue colours replaced by a soft light green, sometimes with very slight bluish intermingling on the metepisternites. Legs and wings as in the opposite sex.

Abdomen short and robust, apical segments considerably widened in both dimensions. Dorsum warm reddish-brown, progressively darker from before backwards and each segment growing darker from base to apex, with blackish-brown intersegmental rings. Pale median longitudinal line distinct on segm. 2 - 4. Basal rings light green dorsally, prolonged laterad into greenish-yellow stripes, which are much broader than in the male, occupying most of the sides of segm. 3 - 6 or 7. Segm. 8 and 9 each with a very large, bright blue-green side-spot, rounded dorsally; 8 in addition with a narrow, azure-blue mid-dorsal line, and 9 with a similar though much wider longitudinal oval azure-blue spot, pointed on both ends. Segm. 10 blackish-brown with a squarish side-spot of blue.

Anal appendages brown, very slender and pointed, apices with 2 or 3 fine dorsal denticles. Valves black save for a large bluish-green basal spot; armature

of lower margin as described by RIS (*loc. cit.* fig. 6); number of spines variable, usually 3 strong, slightly recurved spines in addition to the apical hook but occasionally there are only 2 of such spines, and in a few females there are, in addition, 2 - 4 much smaller spinules, decreasing in size and placed more basad.

Measurements.

The measurements given in the literature are as follows:
♂ abd. + app. 47, hw. 30, pt. 2.5 mm. (RIS, C. Sumatra).
— — — 48, — 28, — — — (FRASER, Borneo).
— — — 42, — 28, — 2.25 - 2.50 mm. (KRÜGER, N.E. Sumatra).
— — (excl. app.) 48, hw. 31, pt. 2.75 - 3 mm. (LAIDLAW, Malaya).
♀ long. corp. 46, exp. al. 55, pt. 2.5 mm. (KIRBY, holotype Borneo).
— abd. (incl. apps?) 43, hw. 32, pt. 2.5 mm. (RIS, C. Sumatra).

In our material the measurements are as follows:
Length: ♂ abd. + app. 50, hw. 30.5, pt. fw. 2.8 mm. (Malaya).
— — — — 45.5 - 51, hw. 31.5 - 32, pt. fw. 3 mm. (Sumatra).
— — — — 47 - 51, — 30 - 31, — — 2.9 - 3.0 mm. (Borneo).
— — — — 43 - 52, — 29 - 32, — — 2.6 - 3.1 — (Billiton).
— — — — 46 - 54, — 31.5 - 34.5, — — 3.0 - 3.4 — (Java).

Long-bodied males with relatively long wings occur together with short-bodied specimens in which the wings are comparatively less shortened, *e.g.* 54, 34, 3.3 mm, and 49.5, 33, 3.5 mm (S. Javan examples).
Length: ♀ abd. + app. 38 - 42, hw. 27 - 30, pt. fw. 2.6 - 2.8 mm. (Billiton).
— — — — 43 - 45, — 31 - 34, — — 3.0 - 3.2 — (Java).

As has been emphasized by me on a previous occasion (LIEFTINCK, *loc. cit.* 1935), and as may appear more obviously from the above descriptions, there remains but little doubt that the examples of *Orolestes* from Sumatra, and of the Malay Peninsula and Billiton as well, are all conspecific with *O. wallacei*. This species was described as a *Lestes* in the first instance. The original description of KIRBY is very poor and by the absence of a male KRÜGER was well justified to describe the specimens from Sumatra as a new species, *viz. Lestes udeana,* KRÜGER.

An examination of the wing-venation of a great number of individuals from various islands makes it evident that *O. udeana* is not a distinct species and can be referred without any difficulties to *wallacei*. The points of distinction between the wing-venation of Sumatran *udeana* and that of an example from Borneo, of which LAIDLAW has published a photograph, are of no specific value since there is a great deal of variability in the neural characters of this species (*cf.* RIS, *loc. cit.*). The number of postnodal cross-nerves for instance, varies considerably, and it has been found that small winged specimens do not necessarily have few cross-nerves, and *vice versa*. Even the ratios between the length and breadth of the wing, the antenodal and postnodal parts of the wing, the

size of the pterostigma and the wing-length, and the length of the costal side of the quadrangle are by no means the same in a series of specimens from one locality [1]).

G e o g r a p h i c a l d i s t r i b u t i o n.

This species was known only from the Malay Peninsula, Sumatra and Borneo. Its recorded range now includes also the islands of Billiton and Java.

In Mr. J. COWLEY's collection are a few specimens of an *Orolestes* from Formosa, of which I have been able to examine one male. It is possible that this species may ultimately require a distinct specific name to hold it, for although it is very similar to *wallacei,* it differs in a few respects.

N o t e s o n t h e l i f e - h i s t o r y o f *Orolestes wallacei.*

Orolestes wallacei was first discovered in Java in October and November, 1935, by Dr. MAX BARTELS, who sent me a small series collected by him on a forest-pool near Tjidaoen, in the wooded coastal district of Tjidamar, South-Java.

I had of course kept a sharp look-out for this species in all our ephemeral collecting-expeditions round Buitenzorg; but it was not until March 26, 1937, that we left Buitenzorg for a three days' Easter-holiday trip to the coastal forests round the Oedjoeng Genteng Bay, situated some 100 kilometres (about 62 miles) as the crow flies south of Buitenzorg and 120 km (74 miles) to the west of the original locality near Tjidaoen, where *O. wallacei* was first discovered.

The weather-conditions were excellent; there had been no rain for about ten days and every morning we enjoyed bright sunshine and a fresh sea-breeze. We were staying at the government rest-house Oedjoeng Genteng, lying immediately behind the beach on a small peninsula, just on the east side of the picturesque landing-stage or pier which is conspicuous in the miniature harbour. Close to the rest-house a deep clearing has been made in the scrub-jungle that extends westwards as a fringe along the coast; from near the harbour directly to the extensive coco-nut plantation about 6 km away from Genteng. During the greater part of the year the narrow gauge lorry-track, for which this clearing has been originally made, is in use for the transport of copra to the harbour. Following this track further inland, one finally reaches the factory-site of Tjitespong Estate.

The first morning of our stay, on March 27, we took a short drive following this clearing in search of good collecting-places. After about 2 miles we discovered and explored thoroughly a number of open sunny pools, some of these boggy, and all fringed with low bushes, reeds and cat's tails. All around the largest of these pools was a dense mass of ferns and shrubbery growing on hard coral-

[1]) A similar considerable variation in size and neuration has been observed by CALVERT and GARMAN in the allied nearctic genus *Archilestes* (Cf. GARMAN, Ent. News, Philad., 43, 1932, p. 85 - 92, figs.).

rock. Although dragonfly-life was abundant and of considerable interest here [1]), after some very hot and trying hours, we stopped collecting, and went home, intending to explore the forest another day. Shortly before leaving, however, I lingered for a while round a boggy pool under the bushes and quite suddenly there flew out from the tangled mass of twigs a large zygopteron; this was secured and proved to be a fine male of *Orolestes wallacei*. No other specimens were seen.

The next morning we set about finding the breeding-places of *Orolestes* and of other species of interest. At about 10 *a.m.*, we penetrated the wood in a place along the path some hundred yards or more back, and entering by a narrow pathway used by native woodsmen, we were soon in the twilight of the scrub.

Owing to the hard calcareous substance of the ground, the coastal stretch of forest which we were about to investigate was devoid of the enormous trees and the rich undergrowth usually found in the jungle. Many huge *Pandanus*-rozettes sent their ribbon-like and prickly leaves in all directions to the ground; but otherwise there were mainly tall trees, thorny palms and lianas, entangled together here and there above one's head in thick masses so as to produce deeply shadowed areas in the thin forest. The soil-surface was flat and consisted of black muddy earth through which a tiny trickling brook found its way to a shallow, leaf-bottomed pool. Ranging further afield we discovered several other pools similar to the last, but with clear stagnant water, often well concealed by overhanging bushes. Some of them were little better than dried up puddles, and the largest was about 6 metres long with a maximum depth of about 2 feet.

All these pools were simply alive with tadpoles of perhaps two species of *Rhacophorus* whose frothy egg-balls, or properly the remnants of these, were noticed several times among the green foliage overshadowing a pool. As regards the tadpoles I wondered how so many had survived; for all the pools were teeming with Dytiscid beetles of which 20 to 30 individuals could be dredged up with a single stroke of my net [2]). Of the zygopterid *Odonata* occurring in these surroundings, two species were particularly abundant among the shady undergrowth near the first pool and its outfall; these were the purplish *Archibasis ?melanocyana* (SELYS), and the slender *Teinobasis euglena* LIEFT. Both species oviposit in the matted tangle of fine submerged rootlets that fringe the steeper sides of the pool through which the brook flowed. Many pairs were taken *in coitu*, and although tenerals of neither were seen more than once or twice, I managed to secure the exuviae of both. An undescribed species of *Copera* was likewise very common here while *Argiocnemis rubescens* SELYS, and the

[1]) This pool is artificial, caused by excavations made when laying the railway. Besides a new species of *Lestes* (*L. praecellens* LIEFT.), we found on this pond-like pool a number of rare species and interesting new larval forms, among others *Lestes praemorsus*, *Ceriagrion erubescens*, *Camacinia gigantea* and *Rhyothemis triangularis*. (See: Treubia, 16, 1937, p. 59 - 62).

[2]) These beetles belonged to two large species, *viz*; *Hydaticus pacificus* AUBÉ, and *Sandracottus maculatus* (WEHNCKE), *Sandracottus* being far outnumbered by *Hydaticus*. We did not find a single larva of these species.

small *Mortonagrion amoenum* (RIS) completed the Agrionid fauna of the marshy part of the forest. The two last mentioned species were very inconspicuous and only found over still water.

The anisopterid fauna was composed mainly of some typically forest-loving *Libellulidae* of the *Agrionoptera*-group, *viz. Agrionoptera insignis* (RAMB.), *Lathrecista asiatica* (F.) and *Potamarcha obscura* (RAMB.), especially the two former being quite common, settling on the tips of dead twigs and branches or hovering in the sunlit-openings over the water. Later on the morning I took two teneral females of a fourth red-bodied member of the same group, *viz. Nesoxenia lineata* (SELYS) [1]). The discovery of this delicate and rare dragonfly was quite a surprise for it is the first locality in Java where this species has been recorded. In habits it resembles *Agrionoptera* closely; both are pre-eminent shade-lovers and very inconspicuous when on the wing. My specimens were persistent as to keeping to their secure positions on a leaf or twig high overhead. Other dragonflies noted here were *Tetrathemis irregularis hyalina* KIRBY, a common though strictly arboreal insect; *Brachydiplax chalybea* BRAUER, and a few species of more universal distribution.

After some hours' work, in a circumscribed area of not over 2 acres in extent (width approximately 50 yd), we got more used to the habits of the species referred to above, and at about 12 *a.m.* we set about investigating a pool for the larvae of *Aeshnidae* and *Mortonagrion*. It was one of the few pools in which a low semi-aquatic plant with small roundish leaves was growing; and very soon my attention was attracted to a number of blackish exuviae upon the leaves and stems jutting out an inch or so above the water's surface. Judging from their slender form and size these empty skins were pretty sure to belong to *Orolestes*, a presumption that was almost instantly corroborated by the fact that suddenly there rose up from near the pool a pale, long-tailed dragonfly with glittering wings that flew almost straight up right in front of us and settled on the hanging festoon of a liana, under the shelter of a broad leaf of a palm-tree. On looking at it more closely, it proved at once to be a newly-emerged male of *O. wallacei* that hung motionless and vertically on the bough, its long transparent wings outspread. In the course of half an hour it became evident that most of the insects had been out for some time, for several mature specimens were flushed among the tangled bushes within striking distance of the pool.

The flight of this insect is distinctly Lestine but with some 'archaic' peculiarities. It is very easily disturbed from a twig or bush where it is resting and will make off speedily for one or two yards, and re-settle in any suitable dark place, usually not far above one's head. It has a great fondness for shady places where it may take long rests, adopting invariably the 'hanging' position so advantageous for concealment. I took a small series of both sexes and had several opportunities of observing the efficiency of the colour-scheme of blue, moss green and metallic-green or -brown, which serves to render them almost

[1]) The next day at about 4 *p.m.* the first males and some more females of this species could be secured on exactly the same spot. These were the only individuals seen.

invisible when at rest. The brilliant azure blue segments 8 to 10 of the male, however, are very conspicuous as soon as the insect comes out in the sunshine. Can it be that these sky-blue spots possibly serve as 'recognition-marks' to

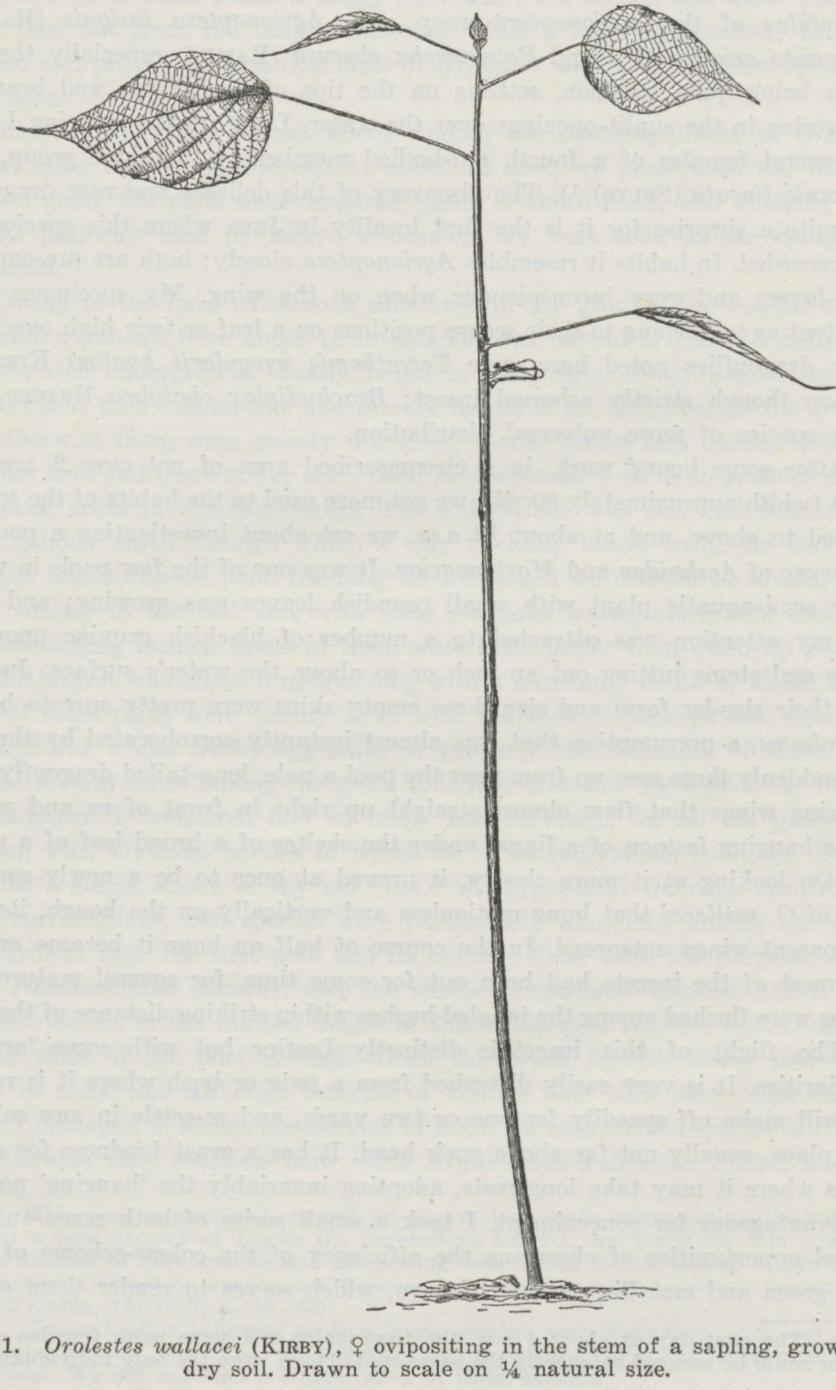

Fig. 1. *Orolestes wallacei* (KIRBY), ♀ ovipositing in the stem of a sapling, growing in dry soil. Drawn to scale on ¼ natural size.

the female during courtship? Although I earnestly looked about in the hope of dislodging a copulating pair, I failed to see any.

Turning back to the pool from which the specimens had emerged, I found several other exuviae on twigs of dead branches fallen into the water, and I picked up two nymphal skins from a tree growing about 3 yards away from the pool. One of these was fastened with outspread legs close to the trunk of the tree, but the other had crawled up the stem to a height of over 5 feet! In using the water-net I found that dragging among the semi-aquatic plants yielded me two full-grown larvae. One of these had its wing-sheaths swollen and it was evident on this warm sunny day that it ascended with the definite purpose of emerging.

The larva is a clean-living creature that avoids the mud at the bottom of the pool, spending most of its time among the dead leaves and submerged twigs; it is almost black in colour with only a slight trace of any markings. In propelling itself it travels in the same manner as larvae of *Lestes,* by a series of graceful half-twists (fig. 4).

Later in the day, at about 2.30 *p.m.,* being on the very verge of leaving the forest for my car to go home, I remember myself glancing cursorily at a male *Agrionoptera* hovering above the black soil in front of me, when, purely by chance, I caught sight of some sort of insect adhering to the smooth stem of a treelet. Creeping cautiously forward, until I was able to sit down within 3 feet of the object, I observed an egg-laying female of *Orolestes wallacei,* hanging motionless and horizontally on the stem of a tiny sapling. This was a mere seedling, rising straight up from the black soil; it was only about 2 feet 3 inches (68 cm) high, and judging from the absence of side-branches and the poor development of leaves it could have been scarcely older than about 6 - 8 months (fig. 1).

The position of the female was most extraordinary (fig. 2). The wings were held horizontally at right angles to the body and she had drawn the tip of her abdomen up until her body had formed a double right-angled bend at the 4th segment, holding the ovipositor between her legs. Evidently I had surprised this female in the middle of the tedious process of oviposition, which was performed very deliberately and slowly. By observing the process of oviposition close at hand I was enabled to note exactly how it went on.

The method of our dragonfly was to select some soft point, guided probably by the styli; she then would saw slowly and longitudinally across the bark with its sharply toothed valves until she could evert the terebra that would make the hole large enough; finally she would slip a single egg into the hole, whereupon the ovipositor is withdrawn. Almost immediately after one egg had been laid the female would start to make a new thrust under the foregoing and repeat the process.

During the oviposition, which was a very lengthy process, the insect remained almost motionless and I was struck by the great muscular strength and hardness of the legs which kept her for a long time in the same position.

She was remarkably indifferent to what happened around her, as I could watch her on every side and easily pick her up by the hand. As time went on the dragonfly at one moment was full in the sun's rays, at another in the dim light of the shady forest.

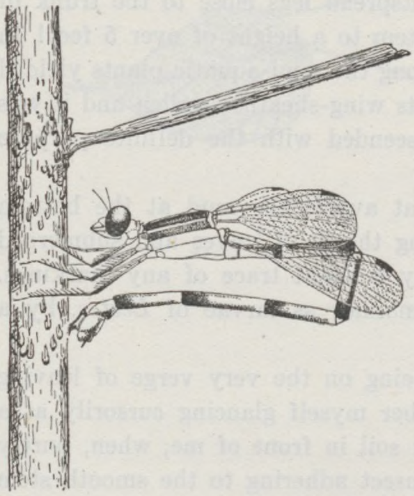

Fig. 2. *Orolestes wallacei* (KIRBY), the same ♀ ovipositing, showing ovipositor and punctures (× 1½).

On my arrival the position of the female was immediately below the stalk of the lowest leaf of the sapling. She was captured at last, after I had watched it ovipositing for one hour and ten minutes, at the end of which time she had backed down the stem imperceptibly about one fourth of an inch, and I am pretty sure that no more than 6 - 8 eggs had been inserted during that period!

Although the genital valves of the female abdomen are armed with a series of enormous teeth, which would seemingly facilitate the operation considerably, I have watched this dragonfly remaining in the same position for many minutes, evidently experiencing much difficulty in scratching open the somewhat hard tissue of the sapling in which the eggs were placed. The movements of the terebra could not clearly be followed but it seems reasonable to conclude that this species has thrown over the laborious usage of some of its relatives (*e.g. Archilestes grandis & californica* [1]); *Lestes viridis* [2]), whose eggs are neatly and regularly arranged in groups or rows, and who measure off with their styli equal distances between the successive incisions. For, turning my attention to the sapling of our ovipositing dragonfly, I noticed several irregular clusters of elongate punctures, placed where the female ovipositor had made a downward thrust. On examining this sapling more closely later, it was found that every thrust contained a single egg and that the eggs had been laid with their narrowest point directed upward. In spite of much careful waiting and watching this was the only time that I saw this species ovipositing.

Before leaving for home I satisfied myself of the fact that the tiny sapling emerged from perfectly dry soil, and that there were no pools within a distance of about 15 yards. Judging from the flat surroundings and the nature of the soil-vegetation we may safely assume that this part of the forest — and the drier zones as well — would be flooded more than once before the wet monsoon set in for good; at which time the whole country must doubtless remain inundated for at least 3 months in succession.

[1]) C. H. KENNEDY, Proc. U. S. Nat. Mus. 49, 1915, p. 259 - 269, figs.
[2]) D. C. GEIJSKES, De Levende Natuur, 33, 1928, p. 17 - 24, 48 - 52, 85 - 90, figs.

If this were not the case the hatching nymphs of our *Orolestes* could not find their way into the water before October; that means six months after oviposition took place, or, in other words after the period that would, under the conditions we are considering, necessarily elapse between the time of oviposition (*viz.* the end of March) and the beginning of the rainy season! This is, of course, impossible. In spite of the drought setting in so early at the time of my observation on the ovipositing female, I believe that, owing to the impermeability of the old coral-bottom, temporary rain-showers would rapidly drench the soil, bringing into existence a number of pools and so would prevent an untimely death of the hatching larvae. For all that it is hardly beyond doubt that at times a pool will dry up too early so that all aquatic animals that can not fly away (except Dytiscid beetles!) or resist prolonged drought, would be doomed to perish. Lack of water is fatal to Lestid larvae and if the final drying up of the pool takes place before the larvae have reached maturity, then they will soon die. From which it will be realized without further explanation that in a fortnight or less, had there been no rain during that period, the young brood of our dragonfly would have died at once.

At last, I pulled out the sapling, wrapped it up in a wet handkerchief and so it was taken along with me to the rest-house. The next day we drove home but unfortunately the sapling died during the journey. As soon as was possible I cut out the particular portion of the stem which contained the eggs, placing it in a petri-dish filled with water, but the eggs soon died and further observations were impossible.

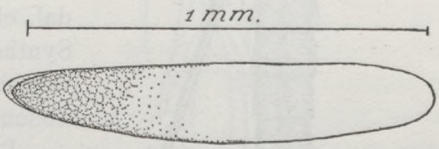

Fig. 3. Egg of *Orolestes wallacei* (Kirby).

The egg.

From the shoot I extracted a fair number of eggs, which I found to be of the typical Lestine form (fig. 3).

Elongate, cylindrical, very slightly curved; anterior pole obtusely pointed, posterior pole well-rounded. Colour pale wax-yellow.

Length 1.08 - 1.12, greatest diameter 0.22 mm.

Description of the full-grown larva (fig. 4).

Total length of body without caudal gills 21 - 22; median gill 8.5, lateral gill 8.8; length of head 2.12, width of same across the eyes 4.38; length of antenna (one specimen) 6.42, of separate joints 1 - 7: 0.80, 0.90, 1.67, 1.40, 0.90, 0.40, 0.25 mm. Length of hind wing rudiment 6.7; of posterior femur (excl. troch.) 6.16 mm.

Body elongate, cylindrical. General appearance very similar to species of *Lestes* though less slenderly built. Head distinctly wider than the thorax, more than twice as wide as long, with large, well-rounded, laterally prominent eyes. Occipital lobes strongly convex, rounded posteriorly and covered with a number of fine spinulose setae. Antennae very long and slender beyond the two basal segments. Labium long and very slender, adpressed to the body; hinge reaching

back between the legs to the middle or almost to the end of the posterior pair of coxae. Mentum at first rather broad, thence tapering and after a slight constriction suddenly triangularly widened in its distal third. Median lobe with 5 very short spinulose setae along each lateral margin; anterior border straight (or very slightly undulated), with the median cleft distinct though closed, 0.16 mm long. Mental setae 5 each side, placed rather close together. Anterior margin of median lobe with a row of very fine denticles. Lateral lobe trifid at its distal portion, consisting of two divisions. The inner division forms a long hook whose inner border is microscopically serrulate; apical tooth of same simple, slenderly incurved. Outer division deeply excised, consisting of two almost equally long, simple, arcuate prongs. Lateral setae 3 in number of which but one is on the body of the lateral lobe, the others being upon the very long and curved movable end-hook. Latero-basal corner of lateral lobe with a conspicuous, crescent-shaped ridge, and latero-apical edge with a single short seta (fig. 5).

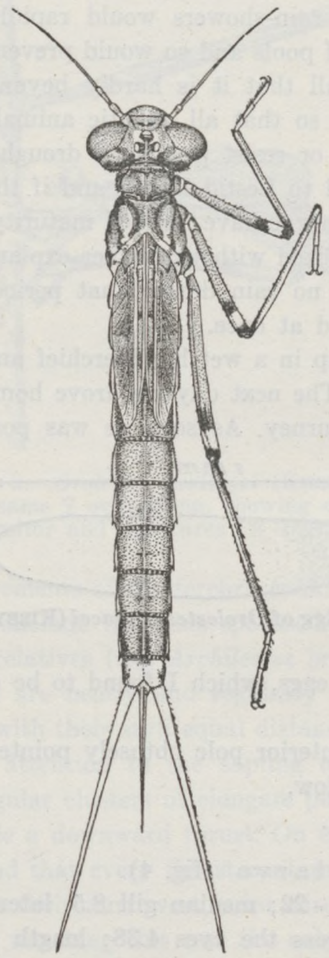

Fig. 4. Ultimate larval instar of *Orolestes wallacei* (KIRBY).

Prothorax wider than long; notum trapezoidal, obtuse-angulate without lateral projections. Synthorax rather robust. Wing-cases parallel, reaching back almost to the end of the fourth abdominal segment.

Legs long and very slender; longitudinal ridges finely denticulate.

Abdomen with cylindrical segments, very slightly tapering towards the apex; sternites and tergites of all segments finely granulate. Lateral ridges smooth, sharply acute, with stout lateral spines on segment 4 - 9 increasing gradually in length, that on 4 vestigial; lateral margins of all segments except 10 microscopically serrulate. Segm. 10 with a sharply compressed dorsal ridge, which ends in a high triangular fold whose posterior margins are strongly spinose.

Caudal gills relatively short and broad, almost parallel-sided with a slight but distinct sub-basal expansion, ventral on the median gill, dorsal on the lateral gill. Apices obtusely truncated. Tracheation distinct, typically Lestine, as is shown in fig. 5.

Coloration. — Generally dark brown. Labium pale with brown lateral stripes to the stalk of the median lobe and an indistinct brown spot on each side of the middle and on the lateral angles. Head mottled with paler brown round the ocelli and on the occipital lobes. Eyes dark olive-brown above,

bluish-grey underneath. Antennae very pale brown, first joint a little darkened on middle.

Pronotum brown, sides almost black; meso-metathorax with alternating dark brown and black vertical bands.

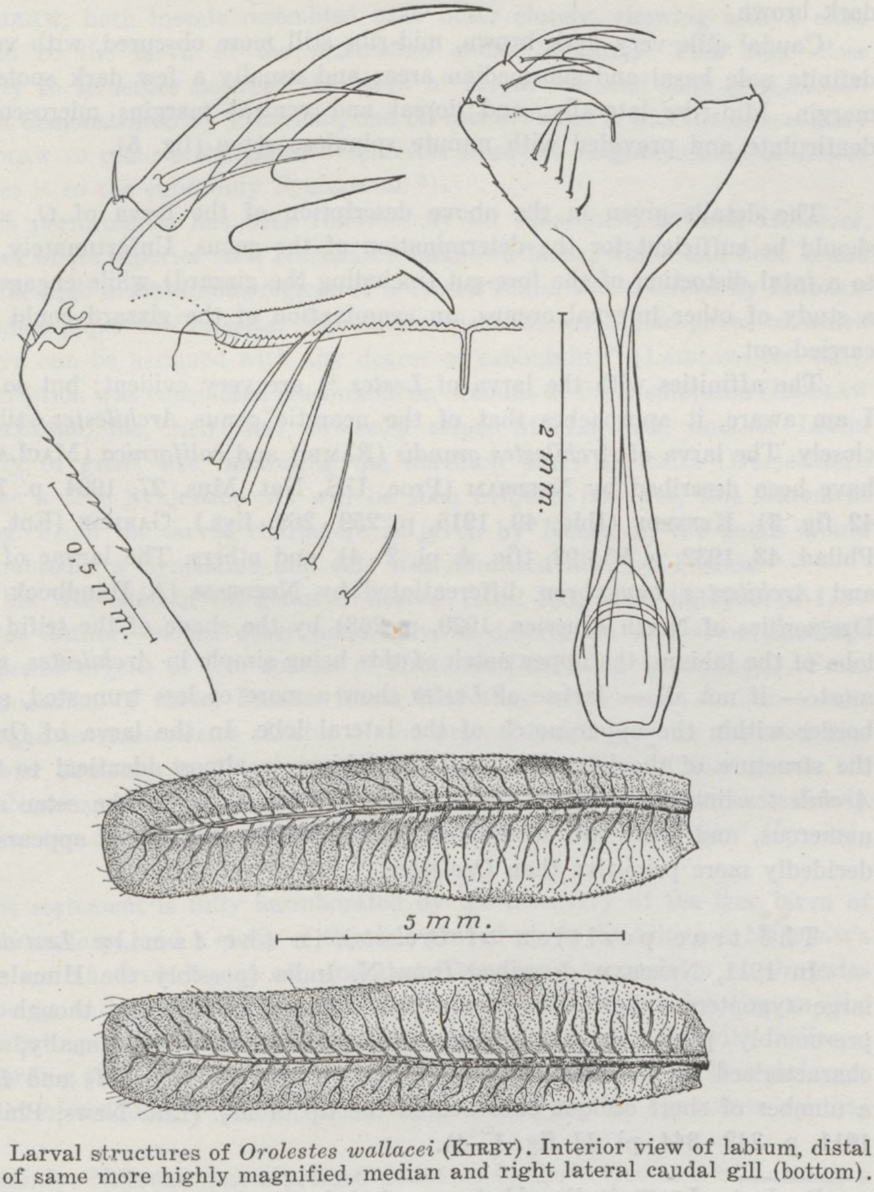

Fig. 5. Larval structures of *Orolestes wallacei* (Kirby). Interior view of labium, distal portion of same more highly magnified, median and right lateral caudal gill (bottom).

Wing-sheaths dark brown with paler brown areas near the base and apex. Legs light brown with distinct dark brown sub-apical rings and with the apices also darkened; tibiae with brown longitudinal ridges, and tarsal joints with the two ridges also finely black.

Abdomen, segm. 1 - 9 dark brown, a little paler dorsally on each side of the middle; the lateral keels are smooth and definitely pale brown in colour, forming an interrupted pale stripe alongside the abdominal segments 1 - 9; apical spines darkened. Segm. 10 pale brown, base and sides diffusely mottled with dark brown.

Caudal gills very dark brown, mid-ribs still more obscured, with very indefinite pale basal and sub-median areas and usually a few dark spots along margin. Mid-ribs laterally, and dorsal and ventral margins microscopically denticulate and provided with minute spinulose setae (fig. 5).

The details given in the above description of the larva of *O. wallacei* should be sufficient for the determination of the genus. Unfortunately, owing to a fatal distortion of the fore-gut (including the gizzard) while engaged with a study of other internal organs, an examination of the gizzard could not be carried out.

The affinities with the larva of *Lestes* [1]) are very evident; but so far as I am aware, it approaches that of the nearctic genus *Archilestes* still more closely. The larva of *Archilestes grandis* (RAMB.) and *californica* (MACLACHLAN) have been described by NEEDHAM (Proc. U.S. Nat. Mus. 27, 1904, p. 712, pl. 42 fig. 3), KENNEDY (Ibid. 49, 1915, p. 259 - 269, figs.), GARMAN (Ent. News, Philad. 43, 1932, p. 85 - 92, tfig. & pl. 2 - 4), and others. The larvae of *Lestes* and *Archilestes* have been differentiated by NEEDHAM (A Handbook of the Dragonflies of North America, 1929, p. 268) by the shape of the trifid lateral lobe of the labium, the upper notch of this being simple in *Archilestes,* whereas most — if not all — larvae of *Lestes* show a more or less truncated, serrated border within the upper notch of the lateral lobe. In the larva of *Orolestes,* the structure of the lateral lobe of the labium is almost identical to that of *Archilestes* but the shape of the mentum is quite different, the setae are less numerous, and there are several other differences. *Archilestes* appears to be decidedly more primitive than *Orolestes.*

The true position of *Orolestes* in the family *Lestidae.*

In 1911, NEEDHAM described from N. India (possibly the Himalayas) a large zygopterous larva which was left unidentified by him though it was presumably placed in the "legion *Podagrion* s.lat." Venationally, it was characterized by the two interpolated sectors between veins M_3 and Rs with a number of short oblique ones behind the tip of M_3. (Ent. News, Philad. 22, 1911, p. 342 - 344, pl. 11 fig. 1 - 4).

[1]) **Lestes* LEACH, in its widest sense, includes a number of other genera, whose generic value must be called in question until a thorough revision of the family *Lestidae* has been given. These genera are: *Africalestes* KENNEDY, *Austrolestes* TILLYARD *Ceylonolestes* KENNEDY, *Chalcolestes* KENNEDY, *Indolestes* FRASER, and *Sympecma* SELYS. Besides these, only *Archilestes* SELYS, *Cyptolestes* WILLIAMSON, *Orolestes* MACLACHLAN, *Platylestes* SELYS, *Superlestes* WILLIAMSON, and probably *Ortholestes* CALVERT appear to belong to the family *Lestidae* in its restricted sense here adopted.**

In 1920, LAIDLAW described the supposed larva of *Megalestes major* SELYS after examples from Pashok, Darjeeling. (Rec. Ind. Mus. 19, 1920, p. 185 - 187, figs. 1 - 3).

Although NEEDHAM's larva was considerably larger than the one described by LAIDLAW, both insects resembled each other closely, showing also a close approach to the larva of the Australian genus *Synlestes*. This very close similarity in structure between the larva of *Megalestes* and that of *Synlestes* was first demonstrated by TILLYARD; and on this evidence it was found necessary by LAIDLAW to remove the genus *Megalestes* from the neighbourhood of *Lestes* and refer it to the subfamily *Synlestinae* [1]).

This performance has been followed by all subsequent writers. However, in respect of its superior size, NEEDHAM's unknown larva, which had been found also in the high mountainous regions of northern India, was ascribed by LAIDLAW in the same paper to *Orolestes*, "the only (other) known Indian genus to which this larva can be assigned with any degree of probability" (LAIDLAW, *loc. cit.*). This ascription was considered reasonable on account of the assumption (LAIDLAW *seq.* TILLYARD, *loc. cit.*) that *Orolestes selysi* MACLACHLAN, another Lestid dragonfly of great size inhabiting the northern parts of India (Darjeeling), would be a true Synlestine. As will be soon evident, however, this statement is wrong. From the larval characters as given by NEEDHAM, the genus would be undoubtedly a Synlestine and this was admitted also by FRASER.

In his "Revision of the genus *Orolestes*" (Rec. Ind. Mus. 35, 1933, p. 175 - 182), this author, on the other hand, gave a description and some drawings of the penile organs of five species of *Orolestes* (including *O. wallacei*). From an examination of these, FRASER found that they are closely similar to the same organ in *Austrolestes* (*Lestes* of the present writer), which fact led him to consider *Orolestes* on this evidence as a modern product of that genus. He adds: "NEEDHAM's larva is more probably a *Megalestes*, which genus is closely related to the *Synlestinae* and probably a genus of that subfamily" (*loc. cit.*, p. 176).

This statement is fully corroborated by the discovery of the true larva of *Orolestes wallacei*, and a study of this has proved up to the hilt that NEEDHAM's larva is not an *Orolestes* at all, and that TILLYARD's supposition of *Orolestes selysi* being a Synlestid, is wrong. As has been pointed out by FRASER, the large Indian species *O. selysi* MACLACHLAN is doubtless congeneric with *wallacei*; and regarding the former we may expect a type of larva which — though larger than that of *wallacei* — shows the same obviously Lestid characters as that species.

Recently, NEEDHAM has expressed doubt as to the correctness of LAIDLAW's identification of his larva as that of *Megalestes major* (Zool. Sinica, A, 11, 1930, p. 229). Nevertheless, in the writer's opinion, the two kinds of Himalayan

[1]) **As will appear later, I have followed TILLYARD (1936), who first gave the *Synlestinae* family-rank. This can scarcely be questioned, especially when the larvae of each of the two subfamilies *Lestinae* and *Synlestinae* are compared together.**

larvae, described subsequently by NEEDHAM and LAIDLAW, are so similar to each other and so obviously Synlestid in appearance, that both of them can be ascribed conveniently to *Megalestes*, which genus then would remain in the *Synlestidae* [1]).

The larval characters of the families *Lestidae* and *Synlestidae*.

Although the larval characters of the three known genera of *Synlestidae* do not, so far as my knowledge goes, support the view that *Chlorolestes*, *Megalestes* and *Synlestes* are closely related *inter se*, these genera on the other hand may remain in this family on account of their larvae, which are fundamentally different in a number of important characters from those of the *Lestidae*.

The larval characters may be tabulated as follows:—

1. Mid-lobe of labium with the median cleft only incompletely developed, very narrowly incised or closed. Side-lobes greatly expanded, usually distinctly concave, mesial margin very irregularly and deeply cleft. Mental and lateral setae present. Antennae long and slender, basal joints of the usual size and appearance, pedicel elongate, not conspicuously longer than the distalia. Gizzard with 4 major and 4 minor folds. Caudal gills very long, sub-parallel, apices ellipsoidal, rounded or bluntly pointed; secondary tracheae approximately at right angles to the main axis. Pedicel of caudal gills unapparent, annular, no "breaking-joint". Gills caducous. Cercoids inconspicuous.

   Fam. *Lestidae*.

   [Genera: *Archilestes* SELYS (Nearctic); *Cyptolestes* WILLIAMSON (Neotropical); *Lestes* LEACH (*s. lat.*) (Cosmopolitan); *Orolestes* MACLACHLAN (Oriental); ? *Ortholestes* CALVERT (West Indies); *Platylestes* SELYS (Oriental); *Superlestes* WILLIAMSON (Neotropical)].

1'. Mid-lobe of labium with the median cleft well-developed, deeply and narrowly incised. Side-lobes narrow and straight, cleft into two simple, unequal teeth; movable hook long and slender. No mental or lateral

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[1]) It may be noted here that NEEDHAM, in his 'Manual of the Dragonflies of China' (*loc. cit.*) does not mention the subfamily *Synlestinae* at all. He places four genera, *viz. Toalestes, Pseudolestes, Megalestes,* and *Lestes* in the subfamily *Lestinae*. Of these, *Taolestes* is undoubtedly synonymous with *Rhipidolestes* RIS, which belongs to the *Megapodagrionidae*; *Pseudolestes* KIRBY belongs to the same family; *Megalestes* belongs to the *Synlestidae*; lastly, *Lestes* is the only genus that should remain in the family *Lestidae*! The supposed larva of *Taolestes*, described also by NEEDHAM, has certainly nothing to do with *Taolestes nectans*, and it should in all probability be referred to some genus of the *Euphaeidae*. NEEDHAM further places *Mesopodagrion, Philosina* and *Rhipidolestes* (all true *Megapodagrionidae* in the opinion of modern odonatologists) along with *Sinolestes* (which is a true Synlestid) in the subfamily *Coenagrioninae*. Lastly, in his "Additions and Corrections" to the Manual (Peking Nat. Hist. Soc. 5, 1931, p. 8), NEEDHAM removes the genus *Pseudolestes* (a Megapodagrionid) from the *Lestinae* (sensu NEEDHAM) and places it in the key to the genera of *Coenagrioninae*!

setae. Antennae variable, usually with the first and second segments stouter than the remaining (except *Megalestes*). First joint long and slender but not as long as second; third segment is the longest (*Chlorolestes*); first joint short and broad, second joint (pedicel) stout and very long, remaining joints much shorter than second joint (*Synlestes*); or antennae rather short, segments subequal in length, third joint longest (*Megalestes*). Gizzard with 8 major folds, no minor folds (*Chlorolestes*), or with 4 major and 4 minor folds (*Synlestes* and ?*Megalestes*). Caudal gills short or moderately long, elongate-oval, narrowed somewhat at their bases; apices broadly rounded (*Megalestes, Chlorolestes*), or bluntly pointed (*Synlestes*); secondary tracheae oblique to the main axis. Pedicel of caudal gills distinct, flattened, forming part of the gill lamella and separated from this by a "breaking-joint". Gills not caducous. Cercoids acute, conspicuous. .... Fam. *Synlestidae.*

[Genera: *Chlorolestes* SELYS (Ethiopian); *Megalestes* SELYS (Oriental); *Sinolestes* NEEDHAM (Oriental); *Synlestes* SELYS (Australian)].

ON PREHISTORIC MAMMALS FROM SOUTH CELEBES

by

Dr. K. W. DAMMERMAN

(Zool. Museum, Buitenzorg).

Up till now very little has been published about prehistoric mammals from Celebes. The nephews SARASIN have explored some caves in South Celebes in the neighbourhood of Lamontjong [1]). The animal remains detected in these caves are described at length and the following species of mammals are recorded:

Anoa depressicornis	*Lenomys meyeri*
Cervus moluccensis	*Mus neglectus*
Babirussa alfurus	*Mus* spec.
Sus celebensis	*Sciurus* spec.
Macacus maurus	*Cephalotes peroni*
Phalanger ursinus	*Pteropus alecto*
Phalanger celebensis	*Canis familiaris*
Paradoxurus hermaphroditus	*Bubalus bubalus*

All the bones were badly broken and smashed into small fragments, there was not a single marrow-bone, vertebra, skull, or even a mandible which was not damaged, except some belonging to such small animals as rats. The majority of these pieces do not allow a satisfactory identification: only the teeth and the articular extremities furnish adequate material for determination.

Of the above-mentioned mammals the Moluccan deer (*Cervus moluccensis*) does not belong to the prehistoric fauna proper, only two incisors of this species having been found among iron ware and China cups in a cave still in use today. As no remains of deer were detected in any of the other caves we are certainly dealing here with a recent importation. The SARASINS said therefore that the principal conclusion revealed by their researches was the absence of the deer and the presence of the babirusa: "Der wesentlichtste Unterschied der Höhlenfauna von der heutigen ist das Fehlen des Hirsches und die Anwesenheit des Babirusa" (l.c. p. 53). The babirusa does not occur in South Celebes today.

As may be seen from the following description we also did not meet with deer remains among the material at our disposal. All other mammals detected by the SARASINS were also represented in our collections except the species of *Paradoxurus, Sciurus, Cephalotes* and *Pteropus.* There may be some doubt whether *Paradoxurus hermaphroditus* was present in prehistoric times in Celebes

[1]) SARASIN, P. u. F. Versuch einer Anthropologie der Insel Celebes, Th. 1, Die Toala-Höhlen von Lamontjong, 1905.

and is not an introduction, like the deer, of more recent times. The remains of this beast of prey excavated by the SARASINS are rather scanty: two lower canines and a piece of a right maxilla with some milk-teeth. The SARASINS themselves are not so quite positive about the identification and, moreover, the remains may have got into the deposits fortuitiously.

Similar caves as explored by the SARASINS were examined by the late Dr. P. VAN STEIN CALLENFELS, the well-known archaeologist, in 1933 - 34. These caves were the Liang (= cave) Tomatoa Katjitjang and Liang Sebong, directly north of Tjani (Lamontjong) in South Bone. The top layer of the deposits in these caves must be quite modern as it contains pottery and is still in use. (The material from this layer bears the numbers 1 - 200.)

In 1937 a few more caves were excavated by the same authority: Panisi Ta'boettoe, near Watampone, district of Palaka, Central Bone; and Liang Batoe Edjaja and Liang Panganrejang toedeja, both situated on the south coast near Bonthain [2]). The deposits of the last cave are divided into the layers A-B and C-D. The first layer is said to date from about the beginning of the Christian era; the other one is much older and bears a mesolithic culture.

The mammalian remains discovered at the said localities were put in the hands of the writer for identification. The material is on the whole rather scanty, hardly a single bone being present undamaged. Of all species only the mandibles, which as a rule are more completely preserved than the other bones, and loose teeth allow a reliable determination. Most other bones except those of the limbs are absent; the latter too are badly broken or smashed into small fragments. Not only was the flesh of the animals eaten by the prehistoric hunters, but the marrow from the bones, and the brains seem to have formed a large part of the diet. Of skull-bones only the mandibles and fragments of maxillae are present: all the other bones have been broken into small unrecognizable pieces.

A noteworthy feature of the collection is that all the more typical animals now known from Celebes and restricted mostly to that island are represented: the two species of marsupials of Celebes (*Phalanger ursinus* and *celebensis*), the dwarf-buffalo (*Anoa*), the babirusa and the moor-macaque (*Cynopithecus maurus*). The species of wild pig is also probably the Celebes wild boar (*Sus celebensis*) or a near relative.

The SARASINS call attention to the fact that the molars of the Anoa from the caves explored by them are a little smaller than those of recent dwarf-buffaloes from North Celebes. Our material belongs mainly to juvenile individuals but in the molars from adult specimens we cannot find any noticeable difference in size from those of recent ones.

There are at least four species of rats represented but our collection of this group of animals from Celebes available for comparison is too incomplete to allow an exhaustive identification. One of the species found by the SARASINS

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[2]) See: Tijdschr. Ind. Taal-, Land- en Volkenkunde, Dl. 78, 4, 1938; and Tijdschr. Kon. Ned. Aardr. Gen. 2e R., Dl. 55, 1938, p. 138.

is named *Lenomys meyeri.* We have at our disposal also a few mandibles of a rat species (species a) with a pattern of the molars very similar to that of *Lenomys,* but otherwise these mandibles show some differences when compared with those of the said species. Another species named *Mus neglectus* JENT. (*Mus rattus celebensis* HOFFM.) may probably represent the common house-rat or country-rat (*Rattus rattus* subspec.). Among the material excavated there is also a rat species (species d) closely resembling *R. rattus* but not quite identical.

Besides the above mentioned wild species there are found, moreover, two domesticated animals, the water-buffalo and the house-dog. Both species are from the top-layer of the caves north of Tjani, but as this layer is quite modern these species are certainly a late introduction. However, there are a few bones (two phalanges and a piece of marrow-bone) of the buffalo bearing numbers above 200 and therefore said to be excavated from the lower and older layer. These pieces of bones seem to me to be quite recent and are not incrustated and dark in colour like those of *Anoa* found in the same layer. Therefore I feel some doubt as to whether these pieces are correctly numbered; they may have got among the material from lower deposits by chance.

The main bulk of the material consists of remains of the dwarf-buffalo, the babirusa and the wild pig, and in the most southern caves the Celebes cuscus (*Phalanger celebensis*) is also represented in fairly large numbers. It seems that the said game-animals, in the first place the babirusa, and in some localities also the cuscus, were the main food of prehistoric man in Celebes. In a much less degree the dwarf-buffalo and the wild pig seem to have been taken as in all caves remains of these beasts are less plentiful than those of babirusa.

The remarkable canines of the babirusa were apparently much appreciated by prehistoric man as ornaments: a few tusks cut through and polished came to light. The SARASINS have described similar ornaments from the Lamontjong caves.

The same authors called attention to the absence of the deer-species among the truly prehistoric remains and as mentioned above we also have not detected a single remain of the deer. If the deer really was present in prehistoric times in Celebes, the remains of it would almost certainly have been found, especially the antlers which have always been a material much esteemed by prehistoric man for making tools.

Survey of the species found in the caves.

A. Caves North of Tjani (Lamontjong).

1. buffalo (*Bos bubalis* L.).
2. dwarf-buffalo (*Anoa depressicornis* H. SM.).
3. babirusa (*Babirussa babyrussa* L.).
4. wild pig (*Sus celebensis* M. et SCH.?).

5. domesticated dog (*Canis familiaris* L.).
6. moor-macaque (*Cynopithecus maurus* CUV.).

B. Cave Panisi Ta'boettoe.

1. black cuscus (*Phalanger ursinus* TEMM.).
2. dwarf-buffalo (*Anoa depressicornis* H. SM.).
3. wild pig (*Sus celebensis* M. et SCHL.?).
4. rat-species c.
5. rat-species d.
6. moor-macaque (*Cynopithecus maurus* CUV.).

C. Cave Batoe Edjaja.

1. black cuscus (*Phalanger ursinus* TEMM.).
2. Celebes cuscus (*Phalanger celebensis* GRAY).
3. dwarf-buffalo (*Anoa depressicornis* H. SM.).
4. babirusa (*Babirussa babyrussa* L.).
5. wild pig (*Sus celebensis* M. et SCH.?).
6. rat-species a.
7. rat-species b.
8. rat-species d.
9. moor-macaque (*Cynopithecus maurus* CUV.).

D. Cave Panganrejang toedeja.

Layer A-B, top-layer.

1. black cuscus (*Phalanger ursinus* TEMM.).
2. Celebes cuscus (*Phalanger celebensis* GRAY).
3. dwarf-buffalo (*Anoa depressicornis* H. SM.).
4. babirusa (*Babirussa babyrussa* L.).
5. wild pig (*Sus celebensis* M. et SCH.?).
6. rat-species a.
7. rat-species b.
8. rat-species c.
9. moor-macaque (*Cynopithecus maurus* CUV.).

Layer C-D, older.

1. black cuscus (*Phalanger ursinus* TEMM.).
2. Celebes cuscus (*Phalanger celebensis* GRAY).
3. dwarf-buffalo (*Anoa depressicornis* H. SM.).
4. babirusa (*Babirussa babyrussa* L.).
5. wild pig (*Sus celebensis* M. et SCH.?).
6. rat-species a.
7. rat-species b.
8. moor-macaque (*Cynopithecus maurus* CUV.).

Description of the material.

Phalanger ursinus TEMM.

Cave Panisi Ta'boettoe.

It is with some hesitation that I refer to this species two pieces of bone belonging to a cuscus. One piece is a fragment of the right maxilla beneath the insertion of the zygomatic process, containing four molars (m^1-m^4); the other piece is the anterior part of a right mandible with the whole teeth-row, including the incisors, practically intact.

Among the species of *Phalanger* living nowadays in Celebes our specimen comes nearest to *ursinus* (the Black cuscus) but there are noteworthy differences. In the maxilla the length of the molar series is about the same as in *ursinus* but the molars are much heavier, broader, and more rectangular in shape. The distance between the molar series and the insertion of the jugale is much higher. In the mandible the length of the molar series (p_4-m_4), being 33.8 mm, matches that of *ursinus* again but the second small intermediate tooth is situated more on the innerside of the fourth premolar; moreover, the height of the mandible is greater, being 18.5 mm at p_4 against 17.4 mm in recent *ursinus*.

From *Phalanger maculatus,* the only other large cuscus with which our specimen is comparable, our specimen differs in the manner and the position of the jugal connection with the maxilla, the oblique stand of p_4 and the position of p_3 which in *maculatus* is situated in front of p_4.

Cave Batoe Edjaja.

A fragmentary right mandible with the molars and p_4 intact (length of p_4-m_4, 34 mm). In the length of the molar series and in other respects the specimen exactly matches *ursinus,* excepting in the position of the second intermediate tooth which is as described above; p_4 is set a little obliquely outwards.

Cave Panganrejang toedeja.

From the layer A-B we have before us a fragment of a right mandible with p_4 only and alveoli of other teeth; a very fragmentary piece of a left mandible with p_4 and m_1; one loose third lower molar. The molars are heavier than in *ursinus,* and are as described for the specimen from the cave Panisi Ta'boettoe.

From the older layer C-D there is only one small fragment of a left mandible without teeth.

Phalanger celebensis GRAY.

Cave Batoe Edjaja.

A piece of a left maxilla with part of the zygomatic process, molars p^4-m^3 present, of other teeth, including i^2, alveoli only. Length of molar row a little less and teeth slightly smaller than in recent *Ph. celebensis.* Further, a right and a left mandible are represented; of both the anterior part is missing, of molars p_4 to m_3 preserved, in the left mandible m_2 lost. Length of molar series and size of teeth as in *celebensis,* but in the left mandible the condylus is more projected backwards. All three pieces probably belong to the same specimen but the mandibles have not the same length.

Cave Panganrejang toedeja.

From layer A-B there are 5 right mandibles, all fragments, two with all molars lost, two with only a few molars, and one piece with the molars p_4-m_3 represented. Moreover, 7 left mandibles, far more complete, two without teeth, two with a few molars only, and three with molar series p_4-m_4 intact. Of all mandibles only the central part is present; the anterior part with the incisors and posterior condylar part is always broken off. Besides these mandibles there is also one lower part of a left humerus which probably belongs to this species of cuscus.

In the layer C-D the species is represented by 7 right and 6 left mandibles, all again fragmentary; two right ones only have the molars p_4-m_3 complete; in the left mandibles there is only one with the molar series p_4-m_4 intact.

From this layer two pieces, both lower parts, of a right and a left humerus, were also excavated.

Bos bubalis L.

Caves N. of Tjani (Lamontjong).

In the uppermost layer there were found a number of buffalo teeth, four upper premolars and four upper molars (Nos S. 6; 30, 55, 56, 95, 128, 168). Further, remains of limb-bones and of a buffalo scapula, all smashed into small fragments (Nos 2 - 139).

Moreover, there are a few other small bones bearing higher numbers than 200 and therefore presumably derived from the lower layer of deposits. These are two proximal phalanges (Nos 231 and 271) and a piece of marrow-bone (No. 534).

Anoa depressicornis H. Smith.

Cave N. of Tjani (Lamontjong).

From this cave we have before us one upper premolar (No. 237) and two upper molars (Nos 120 and 211); one lower premolar (No. 460) and two lower molars (No. 119). Besides the teeth there are a few remains of limb-bones (Nos S. and S. 50; 242, 247).

Cave Panisi Ta'boettoe.

Only two small fragments of teeth were brought to light.

Cave Batoe Edjaja.

One upper and one lower molar from a juvenile individual, and one lower incisor are present. Further, scattered pieces of limb-bones and perhaps some vertebrae.

Cave Panganrejang toedeja.

The dwarf-buffalo is represented in the upper layer A-B by one upper molar, two lower molars (m_1 & m_3); and one upper molar and two lower molars from a young specimen. The same layer yielded also some pieces of limb-bones broken into fragments.

From the older layer C-D there are several lower molars, and a number of upper and lower molars from a juvenile specimen.

From this layer a few fragments of limb-bones were alse excavated.

Babirussa babyrussa L.

C a v e N. o f T j a n i (Lamontjong).

A piece of a right maxilla is present, with the molars m^1-m^3 (No. 109); a fragment of a right mandible with m_1 (No. 469), idem with m_2-m_3 (No. 139); a piece of a left mandible with m_1-m_2 (not numbered); idem with the molars p_3-m_2 (No. 223), a fragment with m_1-m_2 (No. 230), two pieces with m_1-m_3 (Nos 220 and 228), two other fragments with the third molar only (Nos 147 and 266).

Moreover, there are a number of loose teeth, both premolars and molars from adult and juvenile individuals, but only one lower incisor.

Bones other than teeth are represented only by a few scanty remains of limb-bones, belonging either to babirusa or wild swine. As we have no skeleton of *Sus celebensis* at hand and the bones of swine and babirusa are rather similar, I am for the moment not able to give a definite identification, especially as the remains before me are so very incomplete.

C a v e B a t o e E d j a j a.

A piece of an upper tusk of a young specimen was among the material from this cave: apparently it was used as an ornament, for it is polished and has the lower part cut away. The greatest diameter is 11 mm.

Beside the said canine (now in the collection of the Archaeological Survey) there are:- two fragments of left maxillae, one from a young individual with the second molar only, the other small piece from an adult, with the molars m^2 & m^3. Further, some stray incisors, premolars and molars, from adult as well as from juvenile specimens; a fragment of a lower tusk.

From this cave too there are a number of limb-bones, mostly broken, and a piece of a scapula, representing either babirussa or swine.

C a v e P a n g a n r e j a n g t o e d e j a.

In this cave too a tusk of babirusa was found which had been used for ornament or tool. It is a piece of an upper canine of a very old individual, measuring in diameter 18 mm and also cut straight through. (This piece is kept in the collections of the Archaeological Survey.)

The babirusa is well represented as rather a large number of bones, although all incomplete, was excavated. There are 8 fragments of right, and 4 of left maxillae, from the layer A-B; further, 2 of right and 4 of left mandibles. Some of these bones are without teeth and with the alveoli only; others are with a greater or smaller number of molars.

There are at least two juvenile specimens, one represented by a piece of a left maxilla with the four last molars complete; and another by a fragment of a right mandible of a very young individual with m_1 and m_2, the third molar being not yet visible. Here also are several loose teeth, incisors, fragments of tusks, premolars and molars, some of which belong to young specimens.

From the same layer there is a large number of remains of limb-bones, but only one piece of a scapula and one of the pelvic bones, either from *Babirussa* or *Sus*.

The older layer C-D yielded also several remains of the babirusa:- A part of a right premaxilla with the first incisor; two pieces of right and three of left maxillae, most fragmentary, some with a single tooth only, others with the series p^3-m^2 complete. Furthermore, there are two pieces of right mandibles, one with three, the other with a single molar (m_3) only; four left mandibles are represented, the most complete part with p_3 to m_2 intact. Moreover, a number of loose incisors, premolars and molars are found, and two fragments of lower tusks. Remains of the limb-bones are also present but all broken into pieces, and, as already told above, we are not able to tell whether they belong to the babirusa or wild swine.

Sus celebensis M. et SCHL. (?)

As there are only fragments of skull-bones and other bones at our disposal we are not quite sure about the identification of the remains belonging to a species of wild swine. The tusks are not larger or heavier than in recent specimens of *Sus celebensis* and the lower ones are similar in cross-section to those of this species. Also in other respects I cannot detect any other outstanding difference from the characters of the recent Celebes wild swine, so, notwithstanding the rather poor material at hand, we most probably are dealing here with *S. celebensis*.

Cave N. of Tjani (Lamontjong).

From this cave we have before us a fragment of a right maxilla with m^2 and m^3 (No. 227), a piece of a left premaxilla with the three incisors (No. 177); two fragments of mandibles each with three premolars (Nos 220 and 237). Two upper tusks of full-grown individuals, and one lower tusk, broken; some upper and lower loose molars, mostly from young specimens.

Cave Panisi Ta'boettoe.

The remains from this cave are very scanty; here were found only two lower incisors and a lower premolar (p_2) and a few fragments of teeth.

Cave Batoe Edjaja.

From this cave too only few bones of wild swine were brought to light:- a piece of a right mandible with the molars m_1-m_3; a few upper and lower incisors, two loose molars, and one upper canine from a juvenile specimen.

Cave Panganrejang toedeja.

This cave yielded the greatest variety of bones of the *Sus* species, especially the younger layer A-B. From the latter layer there are at hand two premaxillae, a left and a right one, the left one with the canine and two premolars, the right one with the canine only, which is broken off. There is, moreover, a piece of bone comprising the symphysis of a mandible with two premolars of the left side; and a fragmentary piece of mandible with one premolar (p_3) only.

Beside these parts there are present several upper and lower tusks, but only one intact, the others all fragmentary; and several single upper and lower incisors, and one upper molar (m^3) from a young individual.

The remains from the lower layer C-D are less numerous:- a fragment of a right maxilla, with the canine; a piece of a left maxilla with the canine and two premolars. Further, a fragment of a right mandible with the tusk, belonging to a juvenile specimen, and a number of loose incisors, a broken upper tusk, and one loose, upper third molar.

Muridae.

In the different caves remains of several species of rat were discovered, but among the bones only mandibles are represented: no other skull-bones were found. As our collection of Celebes rats is far from complete we are not able to identify with any certainty the rather scanty material. At least four species are, however, distinguishable.

Murid species a.

This is the largest rat represented; the lower molars are very heavy and with complicated sculpture, in these respects the species much resembles *Lenomys meyeri* JENT., but the mandible is higher and longer.

Cave Batoe Edjaja:- one left mandible with complete molar series, which is 10.9 mm in length.

Cave Panganrejang toedeja:- from the upper layer A-B there are three right mandibles, two of which are fragments only, one has the molar series intact, length 11.2 mm; three left mandibles, all broken, in two of them all three molars are intact, length 10.7 mm; only two lower incisors are present and these are slender like those of *Lenomys*.

From the older layer C-D we have before us two right mandibles, both fragmentary with incomplete molars; one left mandible with the molar series complete. The latter has a length of 11.8 mm and seems rather too large to be classed with the same species as the remains from the other deposits. This piece may represent another species.

Murid species b.

A large rat but smaller than the preceding one, lower molars less heavy and structure less complicated, lower incisors, however, much broader in antero-posterior section; molar series 9.4 till 9.9 mm.

Cave Batoe Edjaja:- a left mandible with m_1 and m_3 present, length of teeth-row 9.4 mm; another small fragment with m_1 only.

Cave Panganrejang toedeja, layer A-B:- a piece of a right mandible with the incisors and two molars; a fragment of a right mandible with one molar only. Layer C-D: - one right mandible, nearly complete, molar series 9.9 mm; a fragment of a right mandible with the molar row intact, length of same 9.4 mm; one left mandible, nearly complete but m_3 missing; two fragments of left mandibles with incomplete molar series.

Murid species c.

A medium-sized rat, with a lower molar series of 7.9 - 8.5 mm. In sculpture the molars resemble those of *Rattus fratrorum* THOS., but the mandible is much heavier and higher and the lower incisors stronger and broader antero-posteriorly.

C a v e P a n i s i T a' b o e t t o e: - two right mandibles, one nearly complete, only the third molar missing, the other fragmentary but with the molar series intact, length of latter 7.9 mm.

C a v e P a n g a n r e j a n g t o e d e j a, layer A-B: - one right and one left mandible, the right one with m_1 and m_3, length of molar series 8.5 mm; the left one fragmentary.

Murid species d.

The smallest species, about the size of *R. rattus*, but with the lower molars stronger and broader, resembling those of *Rattus hellwaldi* JENT.

C a v e P a n i s i T a' b o e t t o e: - a right mandible, complete, molar series 7.1 mm.

C a v e B a t o e E d j a j a: - one right mandible nearly complete, with a molar series of 6.9 mm.

Canis familiaris L.

C a v e N. o f T j a n i (Lamontjong).

In this cave were found one right upper canine (No. 119) and a right and a left lower canine (S. 42), which exactly match the canines of the domesticated dog.

Cynopithecus maurus CUV.

From different caves there are remains of the Celebes macaque or moor-macaque. The more strongly built mandible conforms with that of *C. maurus*, but the shape of the canines comes nearer to that of *C. niger*. Our material at hand for comparison is, however, too small to elucidate the matter satisfactorily. *C. maurus* is usually considered the representative of *C. niger* in South and Southwest Celebes, and therefore we think it safer to refer our material to *C. maurus*.

C a v e N. o f T j a n i (Lamontjong).

From this cave we have only one piece of a left mandible with m_1 and m_2 (No. 48).

C a v e P a n i s i T a' b o e t t o e.

One left lower canine.

C a v e B a t o e E d j a j a.

A fragment of a right mandible with m_2 and m_3; one right upper canine, deeply grooved on the anterior inner side; one right lower canine, badly broken; one loose, upper third molar.

C a v e P a n g a n r e j a n g t o e d e j a.

From layer A-B there are several upper and lower canines; from the layer C-D a fragment of a left mandible with m_3.

ON SOME *XYLOCOPA*-SPECIES FROM THE SUNDA ISLANDS

(Hymen.: Xylocopidae).

By

TSING-CHAO MAA

(Daw-Tsuen, Hangchow).

The majority of the species reported in the present paper are received from Dr. K. W. DAMMERMAN, Director of the Zoölogisch Museum en Laboratorium, Buitenzorg, Java. A few additional materials are from Mr. E. BANKS of the Sarawak Museum, Kuching, Borneo, Dr. WALTHER HORN, Director of the Deutsches Entomologisches Institut, Berlin-Dahlem, Germany, Dr. A. ROMAN of the Entomologiska Advelningen, Naturhistoriska Riksmuseum, Stockholm, Sweden and Dr. FR. MAIDL of the Naturhistorische Hofmuseum, Vienna, Austria. I am greatly indebted to these gentlemen for their kindness in loaning me the specimens.

The specimens listed in the paper are understood to be of the Buitenzorg Museum, otherwise specially mentioned.

Genus **XYLOCOPA** LATREILLE (1804).

Subgenus **Nyctomelitta** COCKERELL (1929).

Xylocopa myops RITS.

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1896. *Xylocopa myops*, DALLA TORRE, Cat. Hymen., X, p. 215.
1901. *Xylocopa grandiceps*, CAMERON, Proc. zool. Soc. Lond., I, p. 33, ♀.
1912. *Xylocopa tranquebarica*, MAIDL (in part), Ann. naturh. Hofmus. Wien, XXVI, p. 306.
1918. *Xylocopa grandiceps*, COCKERELL, Entomologist, LI, p. 104, ♀.
1929. *Xylocopa tranquebarica*, DOVER (nec *Fabricius*), Bull. Raffles Mus. Singapore, II, p. 60, no. 23.

♂. — Unknown.

♀. — Differing from *X. tranquebarica* (FABR.) by the following points:

Pubescence. — Face and posterior abdominal tergites without pale fulvous, long, velvety hairs. Pubescence on dorsal and lateral surfaces of thorax paler and with a little greenish tints. That on abdominal tergites sooty brown, erect, not extraordinarily long; posterior margin except the median portion of tergites II-V each with a narrow and dense fascia of whitish hairs; epipygium with dense, short, rufous hairs.

S t r u c t u r e. — Inter-orbital distance at the level of antennal fossae about 9/14 as long as vertico-clypeal distance. Frontal keel apically narrow, very strong, and gradually decreasing in elevation towards the base; median fovea shallow. Supraclypeal region poorly defined, not depressed, medially very smooth and broadly impunctate. Tentorial pits extraordinarily elongate. Clypeus very flat, basally with a rather narrow median impunctate band; basal portion distinctly more elevated than its neighbouring frontal regions. Basal triangular area of mandibles separated from outer marginal suture by a broad, weak keel; outer tooth apically narrowly rounded. Vertex punctate in first-degree-density [1]). Inter-ocellar distance about one and one-half times as long as ocello-ocular distance. Inter-antennal distance and antenno-ocular distance subequal. Wing-vein M about ⅔ as long as M_{1+2} (1st section). Knee-caps on posterior tibiae extending to basal half of tibial length. Abdominal tergites deeply and evenly punctate in first-degree-density.

D i m e n s i o n s. — Length of body ♀ 27 - 32 mm, of anterior wing ♀ 23 - 25 mm.

T y p e - s p e c i m e n s. — ♀, from Banka, deposited in the Leiden Museum (one paratype in the British Museum, London). Type of *X. grandiceps* CAM., ♀, from Singapore, in the British Museum (Natural History), London.

S p e c i m e n s E x a m i n e d. — SUMATRA: Atjeh, Pendeng, 200 m, II.37, A. HOOGERWERF, 1 ♀. — Fort de Kock, 920 m, V.24, E. JACOBSON, 1 ♀. — Bangko, VII.25, Djambi Exped., O. POSTHUMUS, 3 ♀. — Selemoekoe, VIII.25, Djambi Exped., O. POSTHUMUS, 2 ♀. — Silinda, MJÖBERG, 1 ♀ (Stockholm Mus.). — BORNEO: Kaunzak, 11.V.14, 1 ♀ (Sarawak Mus.). — Matang, 7.V.14, H. E. DAVIDSON, 1 ♀ (Sarawak Mus.). — 10th mile, VII.1894, 1 ♀ (Sarawak Mus.). — Quop, III.1894, 1 ♀ (Sarawak Mus.). — Serai, 12.II.10, 1 ♀ (Sarawak Mus.). — "Borneo", 1886, F. BACZES, 1 ♀ (Vienna Mus.) (det. MAIDL as *X. tranquebarica* FABR.).

Besides the Sunda Islands (Sumatra, Java, Borneo), this species is also known to occur in the Malay Peninsula.

R e m a r k s. — The identity of this species has often been confused with *X. tranquebarica* (FABR.) because of their similarity in general appearance and in structural characters. They can be, however, readily separated by the frontal keel, clypeus and abdominal punctuation. F. SMITH's *X. rufescens* (1874) from India and Java, now generally considered as a synonym of *X. tranquebarica* as firstly pointed out by SCHULZ (Ztschr. f. Hymen. u. Dipt., I, p. 273, 1901) is without doubt composed of a mixture of both *X. tranquebarica* from India and *X. myops* from Java. Probably SCHULZ has overlooked the specific difference between *tranquebarica* and *myops*, and the specimens (from Perak, Malay Peninsula) which he considered to be *tranquebarica* are really *myops*.

According to Dr. O. W. RICHARDS's information, the term "clypeus" employed by CAMERON in his description of *X. grandiceps* should be read "labrum". It

[1]) Terminology of ALLEN et JAYNES, Proc. U. S. nation. Mus., LXXVI, 17, p. 4. 1930.

may be of some interest to point out that CAMERON has misunderstood *X. rufescens* F. SM. as a *Coptorthosoma* GRIB.

The clypeal punctuation of the Sumatran specimens is distinctly larger than that of the Bornean ones. This seems to indicate some meaning of zoo-geographical variation, but I cannot express any definite opinion about it until I can have both sexes from different regions.

Subgenus **Biluna** MAA (1938).

Xylocopa nasalis iridipennis (LEPEL.), comb. nov.

1841. *Xylocopa iridipennis*, LEPELETIER, Hist. nat. Hymen., II, p. 188, no. 24, ♂ (nec ♀).
1854. *Xylocopa iridipennis*, F. SMITH, Cat. Hymen. Brit. Mus., II, p. 353, no. 44.
1873. *Xylocopa iridipennis*, F. SMITH, Jour. Linn. Soc. Lond. Zool., XI, p. 393, no. 8.
1874. *Xylocopa pictipennis*, F. SMITH, Trans. ent. Soc. Lond., p. 277, n. 65, ♀.
1876. *Xylocopa iridipennis*, RITSEMA, Tijdschr. v. Ent., XIX, p. 63.
1896. *Xylocopa iridipennis* + *X. pictipennis*, DALLA TORRE, Cat. Hymen., X, pp. 213 & 217.
1912. *Xylocopa* (*Xylocopa*) *iridipennis*, MAIDL, Ann. naturh. Hofmus, Wien, XXVI, p. 287, ♀♂.
1925. *Xylocopa iridipennis*, ALFKEN, Ent. Rundsch., XLII, p. 41.
1925. *Xylocopa fenestrata iridipennis*, DOVER, Ann. Mag. nat. Hist., (9) XV, p. 222.
1926. *Xylocopa iridipennis*, DOVER, China Jour. Sci. & Art, IV, p. 235.
1927. *Xylocopa lunulata*, JACOBSON (nec LEPELETIER), Supplem. Ent. XVI, pp. 94 et seq.
1929. *Xylocopa fenestrata* var. *iridipennis*, DOVER, Bull. Raffles Mus. Singapore, II, p. 59, no. 18.
1933. *Xylocopa lunulata*, ROEPKE (nec LEPELETIER), Misc. zool. sumatrana, no. 78, pp. 1 - 3, 1 pl.

Differing from *X. nasalis auripennis* (LEPEL.) by the following points:

Integument. — Black element on face ♂ more prominent: clypeus usually predominantly black, sometimes purely black. Wings basally greenish, with a little bluish and violaceous tints; medially (up to the apex of enclosed cells) with strong purple lustre; apical marginal area greenish golden, with rich purplish tints; extreme apical margin narrowly purple; the greenish golden lustre being much less brilliant than that in *X. nasalis auripennis*, usually more dominant in posterior wings.

Pubescence. — Sometimes the whitish hairs of ♂ entirely absent.

Structure. — Face with punctures mostly in first-degree-density. Length of antennal segment III subequal to segments IV-VI. Posterior femora of ♀ ventrally punctate in second-degree-density. Lateral portion of abdominal tergites I-II and entire III-VI punctate in second-degree-density.

Variation. — The wings of some specimens are dominantly purplish in the apical portion and bluish green in the extreme apical margin. The punctuation of the Sumatran and Malayan individuals is usually larger and deeper than that of the Javanese ones.

Dimensions. — Length of body ♂ 28 - 32 mm, ♀ 19 - 27 mm; of anterior wing ♂ 25 - 28 mm, ♀ 18 - 26 mm.

Type-specimens. — ♂, from "Inde", probably deposited in the Turin Museum; type of *X. pictipennis* F. SM., ♀, from Java, in the British Museum (Natural History), London.

Specimens Examined. — MALAYA: Hills near Taipin, Perak, 26-30.XII.15, N. ANNANDALE, 1 ♂ (Calcutta Museum). — SINKIEB [1]), J. WOOD-MASON, 1 ♂ (Calcutta Museum). — SUMATRA: Fort de Kock, 920 m, E. JACOBSON, 1 ♂, 1 ♀ (Deutsch. ent. Institut) (det. ALFKEN as *X. lunulata* LEP. = *X. iridipennis* LEP.). — SEBESI I. (Strait Sunda), IV.21, K. W. DAMMERMAN, 1 ♀ (det. ALFKEN as *X. mcgregori* CKLL. and det. MAIDL as *X. auripennis* LEP.). — JAVA: Garoet, Kamodjang, 1400 m, 21.IV.30, M. A. LIEFTINCK, 1 ♂. — Mt. Gedeh, Tjibodas, 1400 m, 1 ♂ (det. MAIDL). — Penandjoeng Bay, Tjimerak, VIII.36, M. A. LIEFTINCK, 1 ♀. — E. Preanger, Singadjaja, 570 m, 18.VIII.28, H. H. KARNY, 1 ♀. — "Java", 1 ♀ (Deutsch. ent. Institut) (det. ALFKEN). — Batavia, 27.VI.-9.VII.06, BRÜNETTI, 1 ♀ (Calcutta Museum). — Buitenzorg, KEMNER, 1 ♀ (Stockholm Museum).

This subspecies has been erroneously recorded from India, Burma, China and the Philippines.

Remarks. — The original description by LEPELETIER is, without doubt, applying to the male sex (not the female as indicated by him). The female of all known species and subspecies of the subgenus *Biluna* is always purely black-haired, while the male is usually "linea antica collari et macula utrinque sub alarum basi, albido villosis." BINGHAM's (1897) remarks "the male with the front entirely black and with no lateral yellow lunules" are incorrect. Presumably LEPELETIER has overlooked this character while describing *iridipennis* and *auripennis*.

ALFKEN has suggested that *X. iridipennis* and *X. lunulata* should be associated as the same species, but I believe it is more reasonable to sink the latter as a synonym of the typical *X. nasalis* WESTW. The name *X. iridipennis* LEPEL. was not included in F. SMITH's monograph of this genus, in which he described *X. pictipennis* as new.

COCKERELL (Philipp. Jour. Sci., XVI, p. 205, 1920) has mentioned that the present subspecies was separable from *X. nasalis mcgregori* (CKLL.) by its longer III antennal segment and by its larger body-size. But these two characters seem to be not quite reliable as shown above (in *mcgregori*, length of anterior wing ♂ 22-23, ♀ 21-24.5 mm).

Subgenus **Zonohirsuta** MAA (1938).

Xylocopa collaris collaris LEPEL.

1841. *Xylocopa collaris* + *X.* (*Schonnherria*) *Dejeanii*, LEPELETIER, Hist. nat. Hymen., II, p. 189, no. 26, ♀ & p. 209, no. 59, ♂.

1854. *Xylocopa collaris* + *X.* (*Schonnherria*) *Dejeanii*, F. SMITH, Cat. Hymen. Brit. Mus., II, p. 353, no. 47 & p. 357, on. 62.

[1]) P. Singkep of the Riouw Archipelago? — ED.

1857. *Xylocopa collaris* + *X. Dejeanii*, F. SMITH, Jour. Linn. Soc. Lond. Zool., II, p. 47, no. 2 & p. 48, no. 6.
1858. *Xylocopa Dejeanii* + *X. collaris*, F. SMITH, Jour. Linn. Soc. Lond. Zool., III, p. 8, nos. 3 & 4.
1864. *Xylocopa collaris* + *X. Dejeanii*, F. SMITH, Jour. Linn. Soc. Lond. Zool., IV, p. 8.
1873. *Xylocopa collaris* + *X. Dejeani*, F. SMITH, Jour. Linn. Soc. Lond. Zool., XI, p. 393, no. 11 & p. 394, no. 21.
1874. *Xylocopa collaris*, F. SMITH, Trans. ent. Soc. Lond., p. 270, no. 46, ♀♂.
1879. *Xylocopa collaris*, TASCHENBERG, Ztschr. f. d. ges. Naturw., LII, p. 589, no. 23, ♀♂.
1896. *Xylocopa collaris*, DALLA TORRE, Cat. Hymen., X, p. 208.
1911. *Xylocopa collaris* (*dejeanii*), COCKERELL, Proc. U.S.nation. Mus., XXXIX, p. 638, ♂.
1912. *Xylocopa* (*Xylocopa*) *collaris*, MAIDL (in part), Ann. naturh. Hofmus. Wien, XXVI, p. 292.
1913. *Xylocopa collaris*, MEADE-WALDO, Jour. Sarawak Mus., I (3), p. 24.
1914. *Xylocopa collaris*, MEADE-WALDO (in part), Ann. Mag. nat. Hist., (8) XIV, p. 455.
1914. *Xylocopa collaris*, FRIESE, Tijdschr. v. Ent., LVII, p. 7, no. 37.
1918. *Xylocopa collaris*, FRIESE, Zool. Jahrb. Syst., XLI, p. 496, no. 39.
1918. *Xylocopa collaris*, COCKERELL, Ann. Mag. nat. Hist., (9) II, p. 384.
1919. *Xylocopa collaris*, COCKERELL, Ann. Mag. nat. HIST., (9) III, p. 241, ♀.
1919. *Xylocopa collaris* var. *bryanti*, COCKERELL, Proc. U. S. nation. Mus., LV, p. 171, ♂.
1920. *Xylocopa collaris*, COCKERELL, Philipp. Jour. Sci., XVII, p. 288.
1924. *Xylocopa* (*Xylocopa*) *collaris* + *X.* (*X.*) *collaris* var. *penangensis*, DUSMET (in part), Trab. Mus. nac. Cien. nat. Madrid, Zool., XLIX, p. 30, no. 47.
1925. *Xylocopa collaris* (typical form), DOVER, Ann. Mag. nat. Hist., (9) XV, p. 225, ♂.
1929. *Xylocopa collaris*, DOVER (in part), Bull. Raffles Mus. Singapore, II, p. 59, no. 20.

Differing from *X. collaris binghami* CKLL. by the following characters:

♂. — Median pale face markings usually extending upwards to lower margin of median ocellus only. Wings much darker, with beautiful violaceous lustre. Pubescence on posterior metatarsi with more dominant black hairs; third abdominal tergite black-haired. Apical half of clypeus scatteredly punctate; epistomal suture usually perpendicular to frontal sutures but sometimes forming obtuse interior angles with the latter; knee-caps on posterior tibiae apically broadly rounded.

♀. — Wings much darker, fusco-brown, basal and apical portions concolorous, with strong and beautiful greenish and violaceous metallic lustre. Pubescence on postgenae down to the level of lower orbital extremities with dominant white hairs. Abdominal tergite I without white hairs.

Variation. — In one of the males from Kuching, Borneo, the ocellar triangle partly ivory-coloured, punctuation on clypeus similar to that of *binghami* CKLL., abdominal tergites III-IV black-haired. In the males from other parts of Borneo, abdominal tergite III with a mixture of pale and black hairs, IV with predominant black hairs and very scattered pale ones. The females from Borneo are with dominant white hairs on face and very scattered white hairs on lateral margins of scutellum; occiput purely black-haired. The females from Mentawei Islands are scatteredly punctate (in third-degree-density) on

median portion of clypeus, with a mixture of dominant black and very scarce short white hairs on genae, thoracic white-haired collar distinctly broader.

Dimensions. — Length of body ♂ 17 - 21 mm, ♀ 16 - 20 mm; of anterior wing ♂ 15 - 16 mm, ♀ 14 - 17 mm.

Type-specimens. — ♀, from Sumatra, ♂ (*X. Dejeanii* LEPEL.) from Java, probably deposited in the Turin Museum; type of *X. collaris* var. *bryanti* CKLL., ♂, from Buitenzorg, Java, in the U.S. National Museum, Washington, D.C.

Specimens Examined. — MENTAWEI ISLANDS: Siberoet Island, IX.24, C. BODEN KLOSS & N.S., 2 ♀. — SUMATRA: Loeboek Sikaping, 450 m, 1923-27, L. HUNDESHAGEN, 1 ♀. — JAVA: Radjamandala, 350 m, 8.VI.32, L. J. TOXOPEUS, 1 ♂. — G. Pantjar, 500 m, VII-VIII.36, F. DUPONT, 7 ♂, 5 ♀. — Djasinga, 150 m, IV.35, M. A. LIEFTINCK, 1 ♂. — Djampang Tengah, Mt. Tjisoeroe, 6 - 800 m, XI.33, M. E. WALSH, 2 ♂. — Djampang, Mt. Tjimerang, XII.32, M. E. WALSH, 1 ♂. — Depok, 27.IX.36, M. A. LIEFTINCK, 1 ♂. — Preanger, Radjamandala, 400 m, 2.I.31, M. A. LIEFTINCK, 1 ♂. — Batoerraden, Mt. Slamat, 800 m, 23.XII.28, F. C. DRESCHER, 2 ♂. — Bantam, Pasaoeran, 23.V.31, M. A. LIEFTINCK, 1 ♂. — Sangiang Tikoro, Tjitaroem, 500 m, 31.VIII.30, L. J. TOXOPEUS, 1 ♂. — Palaboeanratoe, Tjisolok, 2.V.32, M. A. LIEFTINCK, 2 ♂; XII.35, F. DUPONT, 1 ♀. — Mt. Sanggaboeana, 500 m, 22.XII.35, M. A. LIEFTINCK, 2 ♀. — Buitenzorg, KEMNER, 2 ♀ (Stockholm Mus.). — BORNEO (all from Sarawak Mus.): Pulo Burong, IV.1899, 1 ♀. — Matang, 13.III.1898, 2 ♀; VIII.1899, 1 ♂. — Kuching, 19.XI.1895, 1 ♂, 1 ♀; 1 ♀; 26.II.1898, 1 ♂; II.1899, 1 ♂.

Remarks. — COCKERELL (1918) suggested to restrict the typical form of *X. collaris* LEPEL. to the Malayan form and to make Sumatra as its type-locality; later on (1919) he considered the Javanese race distinct from the *forma typica* and named it as var. *bryanti*. In point of fact, the difference between *bryanti* and typical *collaris* as given by COCKERELL appears to be rather insufficient to erect a distinct subspecies or *forma geographica* and I am unable to find out any definite difference between Sumatran and Javanese individuals. I am inclined to the opinion that it will be more reasonable to regard Java as the type-locality of typical *X. collaris* and to sink the var. *bryanti* CKLL. as a synonym of the former.

Xylocopa collaris nigrocaerulea (F. SM.).

1874. *Xylocopa nigro-caerulea*, F. SMITH, Trans. ent. Soc. Lond., p. 279, no. 70, ♀.
1893. *Xylocopa nigrocaerulea*, GRIBODO (in part), Bull. Soc. ent. Ital., XXV, p. 269, no. 17, ♀.
1896. *Xylocopa nigrocaerulea*, DALLA TORRE, Cat. Hymen., X, p. 215.
1912. *Xylocopa (Xylocopa) nigrocaerulea*, MAIDL, Ann. naturh. Hofmus. Wien, XXVI, p. 292, ♀.
1920. *Xylocopa nigrocaerulea*, COCKERELL, Philipp. Jour. Sci., XVI, p. 205, ♀.
1925. *Xylocopa collaris nigrocaerulea*, DOVER (in part), Ann. Mag. nat. Hist., (9) XV, p. 224, ♀ (excl. ♂).

The male sex of this subspecies has never been described so far, and a description of it is thus offered below:

♂. — Differing from the subspecies *X. collaris binghami* CKLL. by the following points: Pale face markings milky yellow, with dominant black hairs, medially extending upwardly to the lower margin of median ocellus only, interrupted along apical portion of frontal keel; regions immediately adjacent to frontal sutures and to basal portion of clypeal sutures black. Breadth of median impunctate band of clypeus about $^1/_6$ of the length of epistomal suture. Vertex and occiput with dominant pale hairs but intermixed with numerous black ones. Dorsum of thorax also mixed with numerous black hairs, which are dominant on anterior portion of scutellum. Thoracic pleurites black-haired, only with a round, purely pale-haired tuft immediately below wing-bases. Wings much darker. Inner surface of intermediate tibiae purely black-haired. Anterior, intermediate and posterior metatarsi also purely black-haired except the basal portion of the intermediate, which is pale-haired; tarsal segments II-V with a mixture of golden and black hairs. Abdominal tergite III black-haired.

D i m e n s i o n s. — Length of body ♂ 19 mm, ♀ 16 - 19 mm; of anterior wing ♂ 18 mm, ♀ 15 - 17 mm.

T y p e - s p e c i m e n s. — ♀, from Tondano, Celebes, deposited in the British Museum (Natural History), London; allotype, ♂, in the Buitenzorg Museum.

S p e c i m e n s E x a m i n e d. — C. CELEBES: Todjamboe, near Palopo, 900 m, VII.36, L. J. TOXOPEUS, 1 ♂ (allotype). — Palopo, 2 ♂ (Vienna Mus.). — Patoenoeang, I.1896, H. FRUHSTORFER, 2 ♂ (Vienna Mus.). — 2 ♀, without locality-labels (Vienna Mus.).

R e m a r k s. — In the two males from Palopo, the ocellar triangle is pale-coloured, and the median extension of pale face markings below median ocellus is uninterrupted. In those from Patoenoeang, dorsal surfaces of intermediate and of basal portion of posterior metatarsi are pale-haired, and the abdominal tergite III is covered with few short pale hairs.

The male of this subspecies can be readily distinguished from all other known subspecies of *X. collaris* LEPEL. by the presence of dominant black hairs on pale face markings.

Subgenus **Orbitella** MAA (1938).

Xylocopa perversa perversa WIEDEM.

1824. *Xylocopa perversa,* WIEDEMANN, Anal. Ent., p. 8, ♂.
1827. *Xylacopa perversa,* WIEDEMANN, Bull. Sci. nat. & Geol., X, p. 421, ♂.
1841. *Xylocopa mesoxantha,* LEPELETIER, Hist. nat. Hymen., II, p. 199, no. 45, ♀ (excl. ♂).
1854. *Xylocopa mesoxantha,* F. SMITH, Cat. Hymen. Brit. Mus., II, p. 357, no. 64.
1873. *Xylocopa perversa,* RITSEMA, Tijdschr. v. Ent., XVI, p. 221, ♂, pl. 10, fig. 1 (♂) & fig. 2 (♀).
1873. *Xylocopa mesoxantha,* F. SMITH, Jour. Linn. Soc. Lond. Zool., XI, p. 394, no. 23.
1874. *Xylocopa perversa,* F. SMITH, Trans. ent. Soc. Lond., p. 271, no. 50, ♀♂.
1896. *Xylocopa perversa,* DALLA TORRE, Cat. Hymen., X, p. 217.

1912. *Xylocopa* (*Koptorthosoma*) *perversa*, MAIDL, Ann. naturh. Hofmus. Wien, XXVI, p. 300.
1914. *Xylocopa perversa*, FRIESE, Tijdschr. v. Ent., LVII, p. 7, no. 38.
1935. *Xylocopa perversa*, FRIESE in SCHULTHESS, Rev. Suisse d. Zool., XLII, p. 296.

The following accounts may be supplemented to RITSEMA's re-description of the male:

♂. — Pubescence. — Lateral frontal regions with whitish hairs, which are mixed with a few black ones. Postgenae and vertex immediately posterior to upper orbital extremities with dominant yellowish and a few black hairs. Extreme anterior portion of the yellow longitudinal band of thorax yellowish. The yellowish or whitish hairs usually shorter and more erect than either black or bright yellow ones. Anterior portion of propodeum laterally also yellow-haired; medially with some very scattered yellowish long and soft hairs; posteriorly with sooty-brown hairs. White hairs on dorsal and outer surfaces of anterior tibiae and those of anterior tarsi, and on dorsal surface of intermediate tibiae intermixed with some black hairs. Posterior metatarsi dorsally with very scattered yellowish hairs. Pale hairs on tibiae bright yellow, but those on tarsi yellowish. Lateral margin of abdominal tergites I-V and that of posterior portion of abdominal sternites II-V with few yellow hairs.

Structure. — Inter-orbital distance at the level of antennal fossae about $^{5}/_{6}$ as long as vertico-clypeal distance. Inner orbits strongly curved. Distance between upper orbital extremities very slightly longer than that between the lower. Front evenly punctate in first-degree-density. Frontal keel distinct, narrow and gradually elevating and narrowing towards the apex, which is sharply ended; median fovea deep, V-shaped, basally very wide, forming the basin of median ocellus, apically interrupted. Supraclypeal region very flat, evenly punctate and more elevated than its neighbouring lateral frontal regions. Clypeal sutures weakly curved. Tentorial pits round. Clypeus distinctly more elevated than its neighbouring lateral frontal regions; median impunctate band narrow, weakly carinate. Labrum medially convex, densely punctate, without prominent basal impunctate band; transverse ridge very weak; apical emargination broad and shallow. Genae impunctate, minimum length subequal to the diameter of mandibular punctures. Outer orbital margin with a narrow groove. Postgenae and vertex evenly punctate in first-degree-density. Coronal suture deep. Inter-ocellar distance a little more than twice as long as ocello-ocular distance. Basal side of ocellar triangle about 2.5 times as long as either one of the lateral sides. Inter-antennal distance longer than antenno-ocular distance. Antennal segment III about ⅔ as long as segments IV-VI; V distinctly shorter than VI. Disc of mesonotum impunctate, median portion of scutellum and postscutellum punctate in third-degree-density; remaining portion of dorsum of thorax punctate in first-degree-density. Postscutellum lying on the same level with scutellum and about $^{3}/_{5}$ as long as the latter (in dorsal view); posterior margin very sharply edged and overlapping anterior portion of propodeum. Venter of thorax scarcely pubescent, evenly punctate in third-degree-

density, interspaces between proximate punctures usually longer than twice the diametre of the punctures. Wing-veins $M + M_{1+2}$ (1st section) about one and one-third times as long as M_{1+2} (2nd section); vein R_4 angulate half-way its length. Posterior extension of anterior coxae short, apically blunt. Posterior legs ventrally finely and evenly punctate in third-degree-density; coxae without any prominent tuberculation; trochanters apically narrowly rounded, not projecting; femora very smooth, inner margin very weakly keeled; tibiae ventrally depressed, apically very weakly incrassate; knee-caps V-shaped, small, extending to basal $^1/_3$ of tibial length. Inner teeth of anterior and posterior claws respectively about $^4/_5$ and $^2/_3$ as long as the corresponding outer ones. Abdominal tergites evenly punctate in third-degree-density, without median impunctate band, interspaces between proximate punctures usually about twice as long as the punctual diameter. Posterior margin of epipygium medially with a broad and shallow emargination. Posterior margin of abdominal sternites I-V with a sharp median extension; hypopygium medially keeled.

The female of this species may be re-described as follows:

♀. — Integument. — Black, flagella (except I segment) of antennae testaceous below. Wings similarly coloured as the male, but a little darker.

Pubescence. — Black, but that on face mixed with whitish hairs, postgenae with dominant whitish hairs. Abdominal tergites I-II with bright yellow hairs.

Structure. — Inter-orbital distance at the level of antennal fossae about $^6/_7$ as long as vertico-clypeal distance. Frontal keel improminent; median fovea deep, basally relatively narrow. Clypeus only a little more elevated than its neighbouring lateral frontal regions. Labrum strongly tuberculate. Coronal suture weak. Inter-ocellar and inter-antennal distances subequal to ocello-ocular and antenno-ocular distances respectively. Mesonotum (except the impunctate disc) and lateral portion of scutellum finely and evenly punctate in second-degree-density. Median portion of scutellum scatteredly punctate in third-degree-density. Postscutellum concealed under posterior margin of scutellum. Posterior trochanters apically sharply pointed and ventrally evenly punctate in second-degree-density. Posterior femora ventrally punctate in second-degree-density, inner margin angulate at its mid-way, basal half strongly keeled. Knee-caps on posterior tibiae large, extending to basal $^5/_9$ of tibial length. Inner teeth of anterior and posterior claws respectively about $^1/_2$ and $^1/_3$ as long as the corresponding outer ones. Median furrow of epipygium medially impunctate, uniform in breadth. Hypopygium apically with a median keel. Remaining characters similar to those of the male.

Dimensions. — Length of body ♂ 11 - 13 mm, ♀ 13 - 15 mm; of anterior wing ♂ 11 - 12 mm, ♀ 11 - 13 mm.

Type-specimens. — ♂, from Java, deposited in the Leiden Museum; types of *X. mesoxantha* LEPEL., ♀, from Java also, probably in the Turin Museum.

Specimens Examined. — JAVA: Preanger, Radjamandala, 500 m, 8.II.32, L. J. TOXOPEUS, 2 ♂, 1 ♀. — Buitenzorg, Tjampea, 21.II.37, M. A.

LIEFTINCK, 2 ♂. — Buitenzorg, Bolang, 600 m, 11.V.30, M. A. LIEFTINCK, 1 ♀. — Mt. Pantjar, 500 m, IV.37, F. DUPONT, 1 ♂, 1 ♀. — Djampang Tengah, Mt. Tjisoeroe, 6 - 800 m, III.33, M. E. WALSH, 1 ♀. — Palaboeanratoe, Tjisolok, XII.35, F. DUPONT, 3 ♀. — Depok, 27.IX.36, M. A. LIEFTINCK, 1 ♀. — Djasinga, 150 m, 19.IV.35, M. A. LIEFTINCK, 1 ♀. — NEW GUINEA (?), 1907, 1 ♀ (det. MAIDL).

Xylocopa perversa shelfordi (CAM.), comb. nov.

1902. *Xylocopa shelfordi*, CAMERON, J. Straits Br. Roy. Asiat. Soc. XXXVII, p. 128, ♀♂.

Differing from the *forma typica* in the following characters only:

♂. — Punctures on basal triangular area of mandibles and on dorsum of thorax comparatively denser, coarser and deeper, those on abdominal tergites III-IV comparatively denser. Abdominal tergites V-VI without yellow pubescence.

♀. — Punctures on dorsum of thorax coarser and deeper. Dorsal and lateral surfaces of thorax with greenish yellow hairs.

Dimensions. — Length of body ♂ 14 mm, ♀ 13 - 15 mm; of anterior wing ♂ 12 mm, ♀ 12.5 mm.

Type-specimens. — ♂♀, from Matang, Borneo, deposited in the British Museum (Natural History), London.

Specimens Examined. — BORNEO (all from the Sarawak Mus.): Matang, 3600′, VI.1900, 1 ♂ (compared with type). — Santubong, 2600′, II.1900, 1 ♀. — Kuching, 21.VII.1899, 1 ♀.

Remarks. — This was originally described as a distinct species but it is practically no more than a *forma geographica* of *X. perversa* WIEDEM.

Xylocopa flavo-nigrescens F. SM.

Specimens Examined. — MENTAWEI ISLANDS: Siberoet Island, 11. IX.24, H. H. KARNY, 1 ♀; C. BODEN KLOSS & N.S., 1 ♀. — SUMATRA: Padang, XI.24, C. BODEN KLOSS & N.S., 1 ♀. — Loeboek Sikaping, 450 m, L. HUNDESHAGEN 1 ♂, 4 ♀. — JAVA: Mt. Gedeh, Tjibodas, 1400 m, 1 ♀ (det. MAIDL as *X. confusa* J. PER.). — BORNEO (all from the Sarawak Mus.): Matang Road, 22.XII.12, 1 ♂ (compared with type by G. MEADE-WALDO). — 10th mile, VII.1894, 1 ♀. — Limbang, VI.11, 1 ♀. — Kuching, 2.VI.1898, 1 ♀. — Pulo Burong, IV.1899, 1 ♀. — Tabikang, 13.V.14, 1 ♀.

Xylocopa smithii RITS.

1876. *Xylocopa smithii*, RITSEMA, Tijdschr. v. Ent., XIX, p. 182, no. 7, ♀.
1896. *Xylocopa smithii*, DALLA TORRE, Cat. Hymen., X, p. 218.
1901. *Xylocopa insidiosa*, J. PEREZ, Act. Soc. Linn. Bordeaux, LVI, p. 53, ♀.
1912. *Xylocopa* (*Koptorthosoma*) *smithii*, MAIDL, Ann. naturh. Hofmus. Wien, XXVI, p. 306, ♀.

♂. — Unknown.

♀. — The following notes may be supplemented to the original description of RITSEMA:

I n t e g u m e n t. — Thorax with a little dull greenish purple tints. Wings sometimes violaceous, with a little bluish instead of greenish tints.

P u b e s c e n c e. — Face covered with a mixture of whitish and black hairs. Vertex with some 3 or 4 long black hairs.

S t r u c t u r e. — Inter-orbital distance at the level of antennal fossae about $^{13}/_{16}$ as long as the vertico-clypeal distance. Inner orbits a little curved. Distance between upper orbital extremities slightly shorter than that between the lower. Frontal keel weak, scarcely more elevated than its neighbouring regions; median fovea very weak but rather broad and very deep at its extreme basal portion. Supraclypeal region without median impunctate band. Epistomal suture weakly curved. Tentorial pits deep, round. Clypeus medially impunctate, very smooth, a little elevated but basal portion distinctly more elevated than its neighbouring lateral frontal regions. Labrum rugose, tuberculate, with a deep apical emargination. Genae impunctate, minimum length subequal to the diameter of mandibular punctures. Outer orbital margin with a shallow groove. Postgenae shallowly punctate in first-degree-density. Vertex scatteredly punctate in second-degree-density. Coronal suture inrecognisable. Inter-ocellar and ocello-ocular distances subequal. Basal side of ocellar triangle about 2.5 times as long as either one of the lateral sides. Postocellar pits shallow. Inter-antennal distance and antenno-ocular distance subequal. Antennal segment III slightly shorter than segments IV-VI. Dorsum of thorax mostly punctate in first-degree-density, disc of mesonotum impunctate. Scutellum with a narrow median impunctate band, median portion bordering the median band finely punctate in third-degree-density, extreme lateral portions strongly punctate in first-degree-density. Wing-vein M slightly longer than M_{1+2}(1st section); vein R_4 weakly angulate at a point of basal ⅔ of its length. Posterior extension of anterior coxae short, apically blunt. Posterior trochanters apically narrowly rounded. Inner margin of posterior femora very weakly curved and keeled. Knee-caps on posterior tibiae V-shaped, apical half of upper margin distinct, extending to basal $^1/_2$ of tibial length. Inner teeth of anterior and posterior claws respectively about $^1/_2$ and $^2/_5$ as long as the corresponding outer one. Abdominal tergites punctate in second-degree-density, tergite I without *Acari*-pouch on its front surface, tergites I-V with a narrow median impunctate band. Median furrow of epipygium narrow. Abdominal sternites I-V medially weakly keeled, with posterior extension; hypopygium rather strongly keeled.

D i m e n s i o n s. — Length of body ♀ 16 - 18 mm, of anterior wing ♀ 14 - 16 mm.

T y p e - s p e c i m e n s. — ♀, from Celebes, deposited in the Leiden Museum; type of *X. insidiosa* J. PER., ♀, from Celebes also, in the Paris Museum.

S p e c i m e n s E x a m i n e d. — CELEBES: Malino, S.W. Celebes, 1000 m, VI.36, L. J. TOXOPEUS, 1 ♀. — Todjamboe, near Palopo, C. Celebes, 900 m, VII.36, L. J. TOXOPEUS, 1 ♀.

Xylocopa bryorum (Fabr.).

1775. *Apis bryorum*, Fabricius, Syst. Ent., p. 381, no. 16, ♂.
1781. *Apis bryorum*, Fabricius, Spec. Insect., I, p. 478, no. 19, ♂.
1787. *Apis bryorum*, Fabricius, Mant. Insect., I, p. 301, no. 22 ♂.
1789. *Apis bryorum*, Olivier, Encycl. méthod. Insect., IV, p. 68, no. 40, ♂.
1790. *Apis bryorum*, Gmelin in Linné, Syst. nat. (13th edit.), I (5), p. 2782, no. 108, ♂.
1791. *Apis bryorum*, Christ, Naturg. d. Insect., p. 125, ♂.
1793. *Apis bryorum*, Fabricus, Ent. Syst., II, p. 321, no. 28, ♂.
1804. *Xylocopa ruficornis* + *Bombus bryorum* + ?*B. aestuans*, Fabricius, Syst. Piez., Piez., p. 241, no. 12, ♂, p. 348, no. 28, ♂ & p. 351, no. 44, ♀.
1806. *Xylocopa ruficornis* + *Bombus bryorum*, Illiger, Magaz. f. Insectenk., V, p. 152, no. 25 & p. 172.
1841. *Xylocopa dimidiata*, Lepeletier, Hist. nat. Hymen., II, p. 199, no. 44, ♀.
1854. *Xylocopa ruficornis* + *X. dimidiata* + *Bombus bryorum*, F. Smith, Cat. Hymen. Brit. Mus., II, p. 353, no. 42, p. 357, no. 66 & p.
1873 *Xylocopa ruficornis* + *X. dimidiata*, F. Smith, Jour. Linn. Soc. Lond. Zool., XI, p. 393, no. 7 & p. 394, no. 21.
1874. *Xylocopa bryorum*, F. Smith, Trans. ent. Soc. Lond., p. 275, no. 59, ♀♂.
1876. *Xylocopa ruficornis*, Ritsema, Tijdschr. v. Ent., XIX, p. 62.
1876. *Xylocopa Aruana*, Ritsema, Tijdschr. v. Ent., XIX, p. 178, no. 2, ♀.
1884. *Xylocopa bryorum*, W. F. Kirby, Ann. Mag. nat. Hist., (5) XIII, p. 412, no. 49.
1896. *Xylocopa bryorum*, Dalla Torre, Cat. Hymen., X, p. 206.
1901. *Xylocopa bryorum*, Friese, Bien. Eur., VI, p. 228, no. 29, ♀♂.
1901. *Xylocopa bryorum*, J. Perez, Act. Soc. Linn. Bordeaux, LVI, p. 56, ♀♂.
1904. *Xylocopa bryorum*, Ashmead, Proc. U. S. nation. Mus., XXXIII, p. 149.
1904. *Xylocopa bryorum*, Ashmead, Jour. N. York ent. Soc., XII, p. 3, no. 15.
1905. *Xylocopa bryorum* subsp. *dimidiata*, Cockerell, Ann. Mag. nat. Hist., (7) XVI, p. 224, ♂♀.
1906. *Xylocopa bryorum*, Brown, Philipp. Jour. Sci., I, p. 686.
1907. *Xylocopa bryorum*, Cockerell, Bull. Amer. Mus. nat. Hist., XXIII, p. 228.
1911. *Xylocopa bryorum*, Cockerell, Trans. Amer. ent. Soc. XXXVII, p. 236.
1912. *Xylocopa* (*Koptorthosoma*) *bryorum*, Maidl, Ann. naturh. Hofmus. Wien, XXVI, p. 298, figs. 31 - 32, ♂.
1921. *Xylocopa bryorum*, Hacker, Mem. Queensland Mus., VII, p. 159.
1924. *Xylocopa* (*Koptorthosoma*) *bryorum*, Dusmet, Trab. Mus. nac. Cienc. nat. Madrid, Zool., XLIX, p. 38, no. 61.
1929. *Mesotrichia bryorum aruana*, Cockerell, Amer. Mus. Novit., no. 343, p. 8.
1929. *Mesotrichia bryorum*, Cockerell, Amer. Mus. Novit., no. 346, p. 4.
1935. *Xylocopa bryorum*, Friese in Schulthess, Rev. Suisse d. Zool., XLII, p. 295.

Variation. — The vein *r-m* in the Ceramese male is scarcely recognisable. In some females, the face, postgenae, vertex, occiput and dorsal surface of anterior tibiae covered with dominant dirty greenish yellow hairs, intermixed with very few long black ones; abdominal tergites without yellow hairs.

Type-specimens. — ♂, from "nova Hollandia", deposited in the British Museum (Natural History), London; type of *X. ruficornis* Fabr., ♂, from "Inde orientali", in the Copenhagen Museum, that of *X. dimidiata* Lepel., ♀, from Timor, probably in the Turin Museum, that of *X. Aruana* Rits., ♀, from the Aroe Islands, in the Leiden Museum.

Specimens Examined. — Kei Islands: Ohoider, Kl. Kei N., H. C.

SIEBERS, 2 ♀. — NORTH-EAST NEW GUINEA: Finschhafen, HERTLE, 1 ♀ (det. FRIESE) (coll. MAA). — CERAM, 1 ♂ (Deutsch. ent. Institut) (det. STRAND). — AUSTRALIA: Cape York, 1 ♂, 1 ♀ (Vienna Mus.) (det. MAIDL).

Besides the localities listed above, this species is known to occur in Timor, Aroe Islands, Thursday Islands, New Ireland (Neu Pommern), Tasmania and Hawaii Islands. It has also been erroneously recorded from India, Ceylon, Burma, Malaya, Sumatra, Borneo and Philippine Islands.

Remarks. — *X. ruficornis* FABR., is generally considered as a synonym of *X. aestuans* (LINN.) (in part) or *X. confusa* J. PER. but judging from the kind information from Dr. KAI L. HENRIKSEN of the Copenhagen Museum, it seems to be more probably a synonym of *X. bryorum* (FABR.), which has priority. In case that *X. confusa* and *X. ruficornis* are conspecific, the latter should stand for the former.

Xylocopa dammermani, sp. nov.

♂. — Unknown.

♀. — Integument. — Black; antennal segments IV-XII testaceous below. Wings fusco-brown, darkest at cell $Sc + R_1 + R_2$, with dull violaceous and a little greenish metallic lustre.

Pubescence. — Black. Face and vertex with a mixture of black and yellow hairs. Postgenae white-haired, lower portion intermixed with a few long black hairs. Occiput with dominant brownish yellow and a few long black hairs. Dorsal and upper portion of lateral surfaces of thorax, including tegulae and postscutellum, densely covered with bright brownish red hairs; extreme basal portion of wings with brownish hairs. Dorsal and outer surfaces of anterior femora (extreme apical portion only) and tibiae with dominant yellowish and a few black hairs. Abdominal tergite I thinly covered with numerous brownish red hairs and very few black ones. Apex of abdomen with a little dark sooty-brown hairs.

Structure. — Inter-orbital distance at the level of antennal fossae about $^4/_5$ as long as vertico-clypeal distance. Inner orbits curved, distance between upper orbital extremities longer than that between the lower. Front shallowly punctate in second-degree-density. Frontal keel basally very weak, interrupted in its mid-way, extending to the level of antennal fossae; median fovea basally very deep but apically much weakened. Supraclypeal region very deeply but rather sparsely punctate, without median impunctate band. Epistomal suture curved and ridged. Clypeal sutures weakly curved. Tentorial pits deep, elongate. Clypeus punctate in first-degree-density; median impunctate band narrow, weakly carinate. Labrum tuberculate, apical emargination narrow, rather deep. Genae impunctate, minimum length subequal to the diameter of mandibular punctures. Outer orbital margin not grooved. Postgenae and vertex strongly punctate in second-degree-density. Coronal suture recognisable at its extreme base only. Inter-ocellar distance about $^3/_4$ as long as ocello-ocular distance. Basal side of ocellar triangle about 2.5 times as long as either one of the lateral

sides. Post-ocellar pits deep. Inter-antennal distance and antenno-ocular distance subequal. Antennal segment III shorter than segments IV-VI. Mesonotum with punctures mostly of first-degree-density; disc impunctate. Scutellum laterally punctate in first-degree-density, medially with a rather broad impunctate band. Wing-vein M about one and one-fourth times as long as M_{1+2} (1st section); vein R_4 angulate at a point of basal $^2/_3$ of its length. Posterior extension of anterior coxae short, apically blunt. Ventral surface of posterior coxae punctate in third-degree-density in inner portion, and in first-degree-density in outer portion. Posterior trochanters apically strongly depressed, narrowly rounded. Posterior femora ventrally punctate in second-degree-density, inner margin curved and keeled. Knee-caps on posterior tibiae sharply pointed, extending to basal ½ of tibial length, upper margin apically distinct. Inner teeth of anterior and posterior claws respectively about ½ and ⅓ as long as the corresponding outer ones. Abdominal tergites medially with coarse, deep punctures of second-degree-density, without distinct median impunctate band; laterally punctate in first-degree-density; tergite I bipunctate; median furrow of epipygium long, deep and narrow. Abdominal sternites medially weakly keeled and with weak median extension.

Dimensions. — Length of body ♀ 21 - 23 mm, of anterior wing ♀ 19 - 20 mm.

Type-specimens. — Holotype, ♀, and one paratype, ♀, deposited in the Leiden and Buitenzorg Museums, respectively, one paratype in my collection.

Distribution. — Kambera, N.E. SOEMBA, III.25, K. W. DAMMERMAN, 2 ♀ (Holotype and Paratype); Laora, 100 m, N.W. SOEMBA, IV.25, K.W. DAMMERMAN, 1 ♀ (Paratype).

Remarks. — The name of this magnificent species is respectfully dedicated to Dr. K. W. DAMMERMAN, of the Buitenzorg Museum, to whom I am greatly indebted for his kind help to my *Xylocopa*-studies.

In general appearance, this new species is very near to *X. bryorum* (FABR.) and its variety *hertlei* FRIESE, but can be readily separated from either of them by its characteristic thoracic pubescence, strong wing-vein *r-m* and the presence of *Acari*-pouch on the front surface of the first abdominal tergite.

Xylocopa confusa J. PER.

Variation. — In the 2 females from the Karimon Djawa Islands (Java Sea) and 4 females from Djampang (W. Java), outer orbital margins each with a shallow and interrupted groove, approaching the character of *X. flavonigrescens* F. SM. These may be the hybrids or intermediate form between *X. flavo-nigrescens* and *X. confusa*, because they have been captured on several occasions at the same locality and at the same time. In one of the males from Loeboek Sikaping, vein *r-m* of the left wing is basally suppressed, while the right wing is normal.

Specimens Examined. — MALAYA: Malacca, XII.1899, 1 ♀ (Sarawak Mus.). — SUMATRA: Padang, XI.24, C. BODEN KLOSS & N.S., 2 ♀. — Loeboek

Sikaping, 450 m, L. HUNDESHAGEN, 4 ♂, 4 ♀. — Wai Lima (S. Sumatra), Lampongs, XI-XII.21, H. H. KARNY, 1 ♂. — Medan, MJÖBERG, 4 ♀ (Stockholm Mus.). — Bab Lias, MJÖBERG, 3 ♀ (Stockholm Mus.). — KRAKATAU I., I.1922, 2 ♂ (det. ALFKEN). — VERLATEN EILAND, N., IX.20, 1 ♂ (det. ALFKEN). — SEBESI, IV.21, K. W. DAMMERMAN, 1 ♂ (det. ALFKEN). — JAVA: Djampang Tengah, Mt. Tjisoeroe, 6 - 800 m, IX.33, M. E. WALSH, 3 ♂. — Djampang, Mt. Tjimerang, XII.32, M. E. WALSH, 4 ♀. — Mt. Tangkoeban Prahoe, 1300 - 1700 m, Preanger, I.29, F. C. DRESCHER, 1 ♂. — Buitenzorg, KEMNER, 11 ♀ (Stockholm Mus.). — Buitenzorg, Tjiboerial, 25.V.30, M. A. LIEFTINCK, 1 ♂. — Diëng Plateau, Rawah Bening, VIII.30, T. VAN BENTHEM JUTTING, 1 ♀. — Batoerraden, Mt. Slamat, 23.XII.28, F. C. DRESCHER, 2 ♂. — "Java", NYMAN & MELLB., BOHEMAN, 5 ♂, 6 ♀ (Stockholm Mus.). — KARIMON DJAWA ISLANDS: P. Karimoen, 22 - 30.XI.30, M. A. LIEFTINCK, 1 ♂, 3 ♀. — BORNEO: S'pou, I.1899, 1 ♀ (Sarawak Mus.).

Xylocopa verticalis LEPEL.

Specimens Examined. — SUMATRA: Medan, MJÖBERG, 1 ♂ (Stockholm Mus.).

Xylocopa nobilis F. SM.

1858. *Xylocopa nobilis*, F. SMITH, Jour. Linn. Soc. Lond. Zool., III, p. 8, no. 5, ♀.
1864. *Xylocopa nobilis*, F. SMITH, Jour. Linn. Soc. Lond. Zool., VIII, p. 93.
1873. *Xylocopa nobilis*, F. SMITH, Jour. Linn. Soc. Lond. Zool., XI, p. 394, no. 27.
1874. *Xylocopa nobilis*, F. SMITH, Trans. ent. Soc. Lond., p. 279, no. 71, ♀.
1896. *Xylocopa nobilis*, DALLA TORRE, Cat. Hymen., X, p. 216.
1901. *Xylocopa nobilis*, J. PEREZ, Act. Soc. Linn. Bordeaux, LVI, p. 64, ♀.
1912. *Xylocopa* (*Koptorthosoma*) *nobilis*, MAIDL, Ann. naturh. Hofmus. Wien, XXVI, p. 298.

♂. — Unknown.

♀. — The original description and later remarks of the female of this species given by F. SMITH are not quite the same. The following accounts may be supplemented to his later remarks.

Integument. — Antennal segments IV-XII testaceous below.

Pubescence. — Face, especially regions near antennal fossae covered with an intermixture of black and a few yellowish hairs. Postscutellum laterally with some yellow hairs. Lateral surfaces of thorax with 2 narrow transverse bands of sparse yellow hairs. Abdominal tergites II-III laterally and III posteriorly margined with ferruginous hairs. Ventral extension of tergites II-III mixed with very few long black hairs. Abdominal sternites covered with ferruginous hairs, intermixed with very few black ones.

Structure. — Inter-orbital distance at the level of antennal fossae about ¾ as long as vertico-clypeal distance. Inner orbits very weakly curved, distance between upper orbital extremities distinctly longer than that between the lower. Face strongly punctate in first-degree-density, except supraclypeal region and regions immediately neighbouring ocellar triangle where it is in second-degree-density. Frontal keel basally suppressed, apically a little more elevated than

its neighbouring regions; median fovea basally broad, very deep, apically very weak. Epistomal suture curved, ridged. Tentorial pits small, round. Median impunctate band of clypeus weakly carinate. Labrum strongly tuberculate and with a rather deep emargination. Genae impunctate, minimum length about 1.5 times as long as the diameter of mandibular punctures. Outer orbital margins with a deep groove. Postgenae and vertex punctate in second-degree-density. Coronal suture inrecognisable. Inter-ocellar distance about $\frac{2}{3}$ as long as ocello-ocular distance. Basal side of ocellar triangle about 3.5 times as long as either one of the lateral sides. Post-ocellar pits deep, round. Inter-antennal distance about $^{13}/_{15}$ as long as antenno-ocular distance. Antennal segment III shorter than segments IV-VI. Dorsum of thorax evenly and strongly punctate in first-degree-density, except the disc of mesonotum and median band of scutellum, which are impunctate. Posterior margin of scutellum a little elevated. Wing-vein M about one and three-fourths times as long as M_{1+2}(1st section); vein r-m strongly curved, basally weak, uninterrupted; vein R_4 curved at a point of basal $\frac{2}{3}$ of its length. Posterior extension of anterior coxae short, uniformly slender and apically blunt. Posterior trochanters posteriorly broadly rounded. Inner margin of posterior femora very weakly curved and keeled. Knee-caps on posterior tibiae V-shaped, extending to basal $^{2}/_{5}$ of tibial length, upper margin apically distinct. Inner teeth of anterior and posterior claws respectively about $^{3}/_{5}$ and $^{1}/_{2}$ as long as the corresponding outer ones. Abdominal tergites evenly and strongly punctate in first-degree-density, without median impunctate band; median furrow of epipygium short, shallow, and narrow. Abdominal sternites I-V medially weakly keeled, posterior margin each with a weak median extension; hypopygium apically strongly keeled.

Dimensions. — Length of body ♀ 25 mm, of anterior wing ♀ 21 mm.

Type-specimen. — ♀, from Celebes, deposited in the British Museum (Natural History), London.

Specimens Examined. — S. CELEBES: Malino, 1000 m, VI.36, L. J. TOXOPEUS, 1 ♀.

Besides Celebes, this species has also been recorded from Amboina and the Soela Islands.

Xylocopa cariniventris, sp. nov.

♂. — Integument. — Black, but two small spots between lateral ocelli, supraclypeal region, clypeus, basal portion of labrum, basal spots of mandibles and under surface of antennal segments I and III ivory-coloured; antennal segments IV-XIII ferruginous below; posterior margin of abdominal segments with more or less reddish tints. Wings basally subhyaline, cells $Sc + R_1 + R_2$, R and R_5 and apical marginal area smoky, with coppery and rosy-purplish metallic lustre.

Pubescence. — Head, thorax including tegulae and extreme basal portion of wings, dorsal surface of anterior and intermediate tibiae covered with yellowish green hairs; but those on front, lower portion of postgenae,

vertex, occiput, postscutellum, propodeum, anterior portion of thoracic pleurites intermixed with more or less black hairs; posterior half of thoracic pleurites, thoracic meso- and meta-sternites and ventral surface of all tibiae with pure or predominant black hairs; thoracic prosternite and anterior coxae and trochanters with pure golden brownish hairs; anterior tarsi with golden (intermixed with very slight greenish or brownish tints) hairs; anterior metatarsi ventrally with a little brownish tints and mixed with some short black hairs; intermediate coxae and trochanters covered with a mixture of black and greenish golden hairs, the latter being much predominant along inner margin; hairs on intermediate tarsi similarly coloured as the anterior pair, but with more brownish tints; posterior legs mainly black-haired, but apex of femora with numerous brownish hairs, outer surface of tibiae basally with a narrow longitudinal band of brownish golden hairs, apex of tarsi with numerous ferruginous hairs; abdominal tergites I-II mainly with sooty brownish or blackish hairs, but intermixed with numerous (especially anterior portion of the II) short greenish ones; tergites III, IV and basal portion of V black-haired; lateral margin of tergites II-V (more or less), posterior portion of the V, and entire VI-VII (VI basally mixed with some black hairs) and posterior margin of abdominal sternites III-VI all with bright ferruginous hairs; the remaining portion of sternites black-haired.

Structure. — Inter-orbital distance at the level of antennal fossae about ⅔ as long vertico-clypeal distance. Inner orbits weakly curved, distance between upper orbital extremities only weakly perceptibly longer than that between the lower. Front, except supraclypeal region, finely punctate in first-degree-density. Frontal keel basally suppressed, apically narrow, rather strong; median fovea basally deep and narrow. Supraclypeal region very finely punctate in third-degree-density, without median impunctate band, discally weakly convex. Epistomal suture W-shapedly curved. Clypeal sutures rather strongly curved. Tentorial pits very shallow. Clypeus basally very smooth and very flat, but more elevated than its neighbouring lateral frontal regions; punctuation very fine, of third-degree-density; median impunctate band rather broad but not in uniform breadth and medially a little depressed. Labrum with fine dense punctures and deep, broad, apical emargination; transverse ridge laterally very weak, medially comparatively strong. Genae impunctate. Base of mandibles running tangent to lower orbits. Postgenae finely punctate in second-degree-density. Vertex evenly punctate in first-degree-density. Coronal suture only recognisable at the base. Inter-ocellar distance about one and one-third times as long as ocello-ocular distance. Basal side of ocellar triangle about 4 times as long as either one of the lateral sides. Inter-antennal distance about one and one-half times as long as antenno-ocular distance. Length of antennal segment III and that of segments IV-VI subequal; both IV and V shorter than broad. Dorsum of thorax punctate in first-degree-density, disc of mesonotum and median band of scutellum impunctate. Scutellum posteriorly roundly-edged and not overlapping postscutellum, which is medially very finely punctate in third-degree-density. Wing-vein $M + M_{1+2}$ (1st section) about one and one-

third times as long as M_{1+2}(2nd section); vein *r-m* basally suppressed, vein R_4 weakly angulate at a point of basal 2/3 of its length. Posterior extension of anterior coxae rather long, crescent-shaped, apically narrowed. Anterior trochanters apically very sharply projected. Posterior coxae ventrally strongly punctate in third-degree-density, apically very weakly tuberculate. Posterior trochanters apically very sharply projecting-out and very strongly depressed, smooth, polished, scarcely punctate. Posterior femora with a very sharp spine at the base of median keel; ventral surface impunctate along inner margin and deeply punctate in third-degree-density along outer margin; inner margin very weakly curved, strongly keeled, basally with a sharp vertical projection. Posterior tibiae apically incrassate, major apical spur forming a V-shaped, apically rounded incrassation; knee-caps small, V-shaped, extending to basal 1/3 of tibial length. Inner teeth of anterior and posterior claws respectively about 3/4 and 2/3 as long as the corresponding outer ones. Abdominal tergites evenly punctate in first-degree-density, without median impunctate band. Abdominal sternites each with a median keel, which is more prominent in posterior segments.

♀. — I n t e g u m e n t. — Black, antennal segments IV-XII dull testaceous below. Wings fusco-brown, darkest in the cell $Sc + R_1 + R_2$, with strong violaceous iridescence, apically with some bluish tints.

P u b e s c e n c e. — Black, but mesonotum, tegulae and median portion of scutellum (mixed with very few black hairs) covered with reddish brown hairs. Abdomen densely pubescent with short hairs; lateral margin of tergites II-VI, posterior margin of V, and entire VI, and sternites III-VI (posterior margin) all covered with bright ferruginous hairs.

S t r u c t u r e. — Inter-orbital distance at the level of antennal fossae about 9/13 as long as vertico-clypeal distance. Inner orbits very weakly curved, distance between upper orbital extremities very slightly longer than that between the lower. Front strongly punctate in first-degree-density. Frontal keel basally suppressed, apically broad and weak; median fovea very deep, gradually decreasing in depth and in breadth towards the apex. Supraclypeal region convex, medially impunctate, apically distinctly more elevated than basal portion of clypeus. Epistomal suture curved. Clypeal sutures weakly curved. Tentorial pits small, deep, round. Clypeus basally scarcely more elevated than its neighbouring lateral frontal regions, medially impunctate, apical portion laterally strongly punctate in second-degree-density. Labrum strongly tuberculate and deeply emarginated. Genae impunctate, minimum length about 6 times as long as the diameter of mandibular punctures. Outer orbital margins with a deep groove. Postgenae scarcely pubescent, punctate in third-degree-density, interspaces between proximate punctures usually more than twice the punctual diameter. Vertex strongly punctate in first-degree-density. Coronal suture inrecognisable. Inter-ocellar distance about 5/8 as long as ocello-ocular distance. Basal side of ocellar triangle about thrice as long as either one of the lateral sides. Post-ocellar pits shallow, round. Inter-antennal distance about 3/4 as long as antenno-ocular distance. Lengths of antennal segment III and segments IV-VI

subequal; IV slightly longer than broad; V and VI subequal. Dorsum of thorax strongly punctate in first-degree-density, disc of mesonotum and median band of scutellum impunctate. Posterior extension of anterior coxae pointed, a little curved. Posterior trochanters apically rounded. Knee-caps on posterior tibiae small, V-shaped, extending to basal $^3/_7$ of tibial length. Inner teeth of anterior and posterior claws respectively about ⅔ and ½ as long as the corresponding outer ones. Abdominal tergites I and VI finely punctate in second-degree-density, II-V strongly punctate in first-degree-density, median furrow of epipygium deep, narrow. Abdominal sternites VI (posteriorly) and I-IV (medially) each with a weak keel and a very weak posterior extension, V posteriorly with a narrow and strong median keel.

D i m e n s i o n s. — Length of body ♂ 27 - 28 mm, ♀ 26 - 27 mm; of anterior wing ♂ 24 - 25 mm, ♀ 26 - 27 mm.

T y p e - s p e c i m e n s. — Holotype, ♂, allotype, ♀, deposited in the Leiden Museum, and one paratype ♂, deposited in the Buitenzorg Museum; two paratypes, 1 ♂, 1 ♀, in my collection.

D i s t r i b u t i o n. — C. CELEBES, Todjamboe, near Palopo, 900 m, VII.36, L. J. TOXOPEUS, 3 ♂, 2 ♀.

R e m a r k s. — This new species is rather near to *X. thoracica* FRIESE (of which only ♀ is known) from Toli-Toli, N. Celebes. But in the latter species, the scutellum is "wohl gekantet, aber nicht aufgebogen", and the abdominal tergite II is laterally black-haired; while in the new species, the scutellum posteriorly is sharply truncate and distinctly overlapping postscutellum, and the abdominal tergite II laterally is brightly ferruginous-haired.

Xylocopa grubaueri FRIESE.

1903. *Xylocopa grubaueri*, FRIESE, Ztschr. f. Hymen. u. Dipt., III, p. 205, ♂.
1903. *Xylocopa* (*Koptorthosoma*) *sarawakensis*, CAMERON, Jour. Straits Br. Roy. Asiat. Soc., XXXIX, p. 180, ♂.
1916. *Xylocopa malaya*, MEADE-WALDO (nec CAMERON), Ann. Mag. nat. Hist., (8) XVII, p. 465.
1924. ? *Xylocopa* (*Xylocopa*) *volatilis*, DUSMET (*nec* F. SMITH), Trab. Mus. nac. Cienc. nat. Madrid, Zool., XLIX, p. 36, no. 57, ♂.
1929. *Xylocopa malayana*, DOVER (nec CAMERON), Bull. Raffles Mus. Singapore, II, p. 61, no. 25.
1933. *Xylocopa* (*Mesotrichia*) *grubaueri*, PAGDEN, Stylops, II, p. 76, ♂.

♂. — The following notes may be supplemented to the original descriptions given by FRIESE and by CAMERON:

P u b e s c e n c e. — Front, postgenae, occiput with a mixture of predominant greenish and some black hairs. Clypeus with predominant black hairs. Lateral surfaces of thorax mixed with few black hairs also, ventral surface with predominant black ones. Apical one-fourth of dorsal surface of anterior tibiae, inner and apical one-half of outer surfaces of the same with predominant greenish hairs; remaining portion with predominant black hairs. Dorsal surface

of intermediate tibiae mixed with very few black hairs, ventral surface purely black-haired. Posterior tibiae black-haired, only with 2 greenish longitudinal bands on dorsal surface. Ventral surface of basal half of intermediate tarsi black-haired. Abdominal tergites II-VI each with 2 pale hair-patches on anterior portion but those on II-III less prominent and with more greenish tints; median portion of VII anteriorly with one large pale hair-patch, which sometimes overlaps the apex of abdomen. Abdominal sternites with a mixture of black and greenish hairs, the greenish ones being predominant in the posterior portion except median band of sternites II-V.

S t r u c t u r e. — Inter-orbital distance at the level of antennal fossae about $^{9}/_{10}$ as long as vertico-clypeal distance. Inner orbits weakly curved, distance between upper orbital extremities distinctly longer than that between the lower. Face evenly punctate in first-degree-density. Frontal keel basally very broad, gradually narrowed towards the apex, which is comparatively strong; median fovea weak, basally uniform in breadth. Furrow surrounding median ocellus very shallow. Apical portion of supraclypeal region elevated. Epistomal suture ridged. Clypeal sutures very weakly curved. Clypeus with a very narrow, weakly elevated and sometimes interrupted median impunctate band; basal portion distinctly more elevated than its neighbouring lateral frontal regions. Labrum basally heavily punctate, with a small triangular basal impunctate band, transverse ridge medially distinct, apical emargination rather deep. Genae impunctate, minimum length shorter than the diameter of mandibular punctures. Postgenae and vertex very deeply punctate in first-degree-density. Coronal suture distinct. Inter-ocellar distance and ocello-ocular distance subequal. Basal side of ocellar triangle about thrice as long as either one of the lateral sides. Inter-antennal distance and antenno-ocular distance subequal. Antennal segment III shorter than segments IV-VI; IV longer than broad. Mesonotum medially a little longitudinally ridged, disc impunctate, remaining portion punctate in first-degree-density. Scutellum finely punctate in second-degree-density, medially narrowly impunctate. Postscutellum finely and shallowly punctate in second-degree-density, posterior margin rounded, lying on the same level with scutellum and with lateral corners of anterior portion of propodeum. Wing-vein M about two and one-third times as long as M_{1+2}(1st section); vein r-m usually interrupted at its base; vein R_4 very weakly curved at its mid-way. Posterior extension of anterior coxae short and apically rounded. Anterior trochanters with short, sharp apical extension. Anterior femora ventrally without pubescence, medially weakly depressed. Ventral surface of posterior legs finely punctate in third-degree-density, interspaces between proximate punctures mostly more than thrice the punctual diameter; coxae apically weakly tuberculate; trochanters apically pointed; ventral surface of femora impunctate between median line and inner margin, which is straight, weakly keeled and basally broadly rounded, base of median line with a small, strongly compressed and apically rounded spine-like process; tibiae with weak incrassation apically; knee-caps small, V-shaped, extending to basal ⅓ of tibial length. Inner teeth of anterior and

posterior claws respectively about ¾ and ⅔ as long as the corresponding outer ones. Abdominal tergites deeply punctate in second-degree-density, without distinct median impunctate band, punctuation being most dense on tergite II; epipygium posteriorly with a shallow median emargination. Abdominal sternites punctate in third-degree-density, medially strongly keeled.

♀. — Unknown.

Dimensions. — Length of body ♂ 25 - 29 mm, of anterior wing ♂ 26 - 30 mm.

Type-specimens. — ♂, from Upper Perak, Malacca, deposited in the Berlin Museum; type of *X. sarawakensis* CAM., ♂, from Matang, Borneo, in the British Museum (Natural History), London.

Specimens Examined. — BORNEO (all from the Sarawak Mus.): Matang, V.02, 1 ♂; 1892, 1 ♂; 3600′ VI.1898, 1 ♂. — Top of Matang, 1890 m, 1 ♂.

This species is also known to occur in the Malay Peninsula.

Subgenus **Cyaneoderes** ASHMEAD (1899).

Xylocopa tumida FRIESE.

1903. *Xylocopa tumida*, FRIESE, Ztschr. f. Hymen. u. Dipt., III, p. 205, no. 8, ♀.

♂. — Unknown.

♀. — The following notes may be supplemented to the original description as given by FRIESE:

Pubescence. — Vertex mixed with a few long black hairs. Anterior metatarsi basally with long black and griseous hairs along outer margin, apically bright ferruginous-haired; dorsal surface with brownish black hairs, turning to bright ferruginous towards the apex. Abdominal sternites II-IV with a few pale hairs amidst the predominant black ones.

Structure. — Inter-orbital distance at the level of antennal fossae about $^3/_5$ as long as vertico-clypeal distance. Inner orbits weakly curved, distance between upper orbital extremities a little shorter than that between the lower. Face deeply and evenly punctate in first-degree-density. Frontal keel basally depressed, sharply ended, extending to the level of lower margin of antennal fossae; median fovea long, deep, narrow. Supra-clypeal region evenly punctate. Frontal and epistomal sutures forming acute interior angles at their junctions. Tentorial pits shallow, elongate. Clypeal sutures S-formed. Clypeus basally distinctly more elevated than its neighbouring regions; median impunctate band about ⅓ as broad as the basal margin, smooth, very strongly but not sharply carinate. Labrum with one median and two submedian small but strong tubercles. Mandibles with 2 sharp teeth; inner margin with a broad emargination at a point of basal ⅓ of its length; inner marginal suture incomplete, apically very broad; basal triangular area fused up with median keel, with a few exceedingly minute punctures (in third-degree-density), separated from outer marginal area

by a broad shallow depression; outer marginal suture very weak, extending from a point of ½ to ¾ of mandibular length. Maxillae with some longitudinal striae, which are a little curved and about $^3/_5$ as long as galea. Maxillary palpi with their segment VI distinctly weaker than V and about ⅔ as long as V, which is subequal in length to apical bristles of IV. Genae impunctate, minimum length about twice as long as the diameter of clypeal punctures. Postgenae punctate in first-degree-density, vertex in second-degree-density. Upper orbital margins with a deep groove. Inter-ocellar distance about one and one-third times as long as ocello-ocular distance. Basal side of ocellar triangle about 2.5 times as long as either one of the lateral sides. Post-ocellar pits broad, shallow. Inter-antennal distance and antenno-ocular distance subequal. Coronal suture short, deep. Antennal segment III shorter than segments IV-VI, IV broader than long, V and VI subequal. Disc of mesonotum broadly impunctate, remaining portion of mesonotum punctate in second-degree-density, but extreme anterior and lateral marginal areas punctate in first-degree-density. Tegulae punctate in third-degree-density. Scutellum medially impunctate, laterally punctate in second-degree-density; posterior margin a little elevated. Postscutellum punctate in third-degree-density. Thoracic pleurites punctate in first-degree-density. Thoracic sternites finely punctate in third-degree-density. Wing-vein $M + M_{1+2}$ (1st section) about one and one-half times as long as M_{1+2} (2nd section); vein *r-m* completely suppressed; vein R_4 weakly curved at a point of basal ⅔ of its length; vein R_5 weakly curved; veins *m-m* and M_4 not parallel; veins M_4 and M subparallel. Major apical spur of posterior tibiae about ½ as long as tibial length; knee-caps weak, flattened, broadly blunt, upper margin not distinct. Inner teeth of claws weakly divergent to the outer and about ⅔ as long as the outer. Abdominal tergites without median impunctate band, with deep coarse punctures of second-degree-density, except the median portion of tergite I, where it is finely punctate in third-degree-density. Abdominal sternites bipunctate, primary punctures of second-degree-density, medially with a broad impunctate band; hypopygium with a median keel apically.

D i m e n s i o n s. — Length of body ♀ 16 mm, of anterior wing ♀ 16 mm. Breadth of head ♀ 6.5 mm, of abdominal segment II ♀ 8.5 mm.

T y p e - s p e c i m e n s. — ♀, from Banka Island, deposited in the Vienna Museum. I have studied one of the types through the kindness of Dr. FR. MAIDL.

Xylocopa caerulea (FABR.).

1914. *Xylocopa* (*Koptorthosoma*) *caeruleiformis*, MEADE-WALDO, Ann. Mag. nat. Hist., (8) XIV, p. 454, ♀♂.

1916. *Xylocopa* (*Koptorthosoma*) *caeruleiformis* var. *fusca*, MEADE-WALDO, Ann. Mag. nat. Hist., (8) XVII, p. 465, ♀.

1916. *Xylocopa* (*Koptorthosoma*) *caerulea* var. *viridis*, MEADE-WALDO, Ann. Mag. nat. Hist., (8) XVIII, p. 565, ♀.

1936. *Xylocopa* (*Cyaneoderes*) *caerulea*, MAA, Ent. & Phytopath., V, p. 357, no. 1, ♂, fig. 1 (♂).

1938. *Xylocopa* (*Cyaneoderes*) *caerulea*, MAA, Rec. Indian Mus., XL, p. (in press).

For further bibliography of this species, reference may be made to my other paper (1938) as cited above.

V a r i a t i o n. — After having studied a long series of both sexes of this species from various regions, I am able to conclude that the body-size as well as the colouration of both integument and pubescence of this species vary individually and that *caeruleiformis* M.-W., *fusca* M.-W., *viridis* M.-W., are not more than its individual aberrations. The dominant pubescence of the male ranges from olive green to brownish green, that of the female ranges from deep azure blue to pale griseous blue. The blue hairs on lateral margin of ♀ abdomen occupy tergite II, or III, or IV, sometimes not beyond I. Wings sometimes with rich purple tints but in some cases purple tints are scarcely perceivable. Length of body ranges from 21 to 28 mm. In the female, the epistomal suture is sometimes weakly ridged and the median impunctate band of clypeus sometimes very flat and sometimes distinctly carinate.

T y p e - s p e c i m e n s. — FABRICIUS's type (from "New Caledonia") and type of *X. semiarmenia* WIED., are probably lost; type of *Cyaneoderes fairchildi* ASHM. deposited in the U.S. National Museum, Washington D.C.; MEADE-WALDO's types all in the British Museum (Natural History), London.

S p e c i m e n s E x a m i n e d. — Besides the material from Hainan, Ceylon, Indochina and Malaya, I have studied specimens from the following localities: MENTAWEI ISLANDS: Siberoet Island, IX.24, C. BODEN KLOSS & N.S., 3 ♀. — Sipora Island, X.24, C. BODEN KLOSS & N.S., 1 ♀. — SUMATRA: Loeboek Sikaping, 450 m, L. HUNDESHAGEN, 1 ♀. — Sibolangit, MJÖBERG, 1 ♀ (Stockholm Mus.). — Fort de Kock, 920 m, XII.21, E. JACOBSON, 2 ♀ (Dtsch. ent. Inst.). — JAVA: Mt. Tangkoeban Prahoe, 1300 - 1700 m, Preanger, I.29, F. C. DRESCHER, 1 ♂. — Batoerraden, Mt. Slamat, 23.XII.28, F. C. DRESCHER, 1 ♀. — Djampangs, Soekanegara, 700 - 1000 m, 23-28.XII.31, M. A. LIEFTINCK, 1 ♀. — Mt. Gedeh, Selabintanah, 1000 m, XII.32, M. E. WALSH, 1 ♀. — Mt. Gedeh, Tjibodas, 1400 m, VIII.22, 1 ♀. — Mt. Gedeh, Tjiboenar, 1000 m, XI.29, DRESCHER, 1 ♀. — Buitenzorg, KEMNER, 4 ♀ (Stockholm Mus.). — Plasan (?—ED.), 1 ♀ (Dtsch. ent. Inst.) (det. MAIDL). — BORNEO: Mt. Kinabalu, 3000′, 10-14.IX.13, 2 ♀ (Sarawak Mus.). — Trusan, VIII.1900, 1 ♀ (Sarawak Mus.). — Bandjar, 1 ♂.

R e m a r k s. — COCKERELL (Entomologist, LI, p. 137, 1918) has suggested that *X. caeruleiformis* would be no more than a race of *X. dormeyeri* (ENDERL.) but as PAGDEN (Stylops, II, p. 78, 1933) has shown, the latter is a species distinctive from *caerulea* (FABR.) and therefore *caeruleiformis* and *dormeyeri* are, although closely related, not conspecific.

Subgenus **Platynopoda** WESTWOOD (1840).

Xylocopa gastrica, sp. nov.

♂. — Unknown.

♀. — I n t e g u m e n t. — Black; under-side of antennal segments IV-XII reddish brown. Wings fusco-brown, darkest at cell $Sc + R_1 + R_2$, R and R_5, with fine purple iridescence, apically with some greenish tints.

P u b e s c e n c e. — Black. Head, dorsum of thorax and abdominal tergites I-IV scarcely pubescent. Propodeum, and front surface and lateral margin of abdominal tergite I with sooty brown and black hairs. Lateral margin of abdominal tergites II-IV and entire V-VI, abdominal sternites II-III (posterior margin) and IV-VI covered with long erect bright golden-brown hairs.

S t r u c t u r e. — Inter-orbital distance at the level of antennal fossae about $^{11}/_{12}$ as long as vertico-clypeal distance. Inner orbits weakly curved, distance between upper orbital extremities a little shorter than that between the lower. Front scatteredly covered with coarse, shallow punctures of second-degree-density, except in the regions immediately exterior to antennal fossae, where it is in first-degree-density. Interspaces between ocellar triangle and inner orbits impunctate. Frontal keel very weak, with a deep and long median fovea. Regions around median ocellus and antennal fossae very strongly elevated, especially that between antennal fossae. Supraclypeal region lying on the same slope with clypeus, with fine scattered punctures of third-degree-density. Epistomal suture weak, curved. Clypeal sutures strongly curved. Tentorial pits elongate, downwardly produced. Clypeus bipunctate, primary punctures fine, of third-degree-density; median impunctate band very flat, with a breadth about ⅓ the length of epistomal suture; basal portion slightly more elevated than its neighbouring lateral frontal regions. Labrum very strongly tuberculate and with a deep and narrow apical emargination. Postgenae impunctate, minimum length about 5 times as long as the diameter of mandibular punctures. Upper portion of outer orbital margins with a narrow, rather shallow groove. Postgenae and vertex very scatteredly punctate in third-degree-density, interspaces between proximate punctures usually about thrice the punctual diameter. Coronal suture inrecognisable. Inter-ocellar distance about $^{9}/_{17}$ as long as ocello-ocular distance. Basal side of ocellar triangle about two and one-third times as long as either one of the lateral sides. Post-ocellar pits round, exceedingly deep. Inter-antennal distance about $^{12}/_{17}$ as long as antenno-ocular distance. Antennal segment III longer than segments IV-V and shorter than segments IV-VI; V and VI subequal. Dorsum of thorax punctate in third-degree-density (except the extreme marginal areas which are punctate in first-degree-density), interspaces between proximate punctures about 6 times as long as the punctual diameter; disc of mesonotum broadly impunctate; posterior margin of scutellum a little elevated; postscutellum finely punctate in second-degree-density. Wing-vein M slightly longer than M_{1+2}(1st section); vein R_4 weakly curved at a point of basal ⅔ of its length; veins M and M_4 not parallel. Knee-caps on posterior tibiae V-shaped, extending to basal ½ of tibial length. Inner teeth of anterior and posterior claws about ½ as long as the outer ones. Abdominal tergites strongly punctate in second-degree-density; the punctuation being a little denser near anterior portion of each segment and being gradually denser, coarser and deeper towards apical segments; interspaces between proximate rows of punctures mostly about 3 - 4 times the punctual diameter in tergites I-II and about twice the diameter in

remaining tergites; tergites III-V with a narrow median impunctate band; median furrow of epipygium short, very narrow and shallow. Abdominal sternites medially weakly keeled, each with a weak posterior extension; hypopygium apically with a very broad and strong median keel, which is with a very shallow and narrow median fovea.

D i m e n s i o n s. — Length of body ♀ 26 mm, of anterior wing ♀ 24 mm.

T y p e - s p e c i m e n s. — ♀, deposited in the Leiden Museum.

D i s t r i b u t i o n. — N.W. SOEMBA: Laora, 100 m, IV.25, K. W. DAMMERMAN, 1 ♀.

R e m a r k s. — In structure, this species is very near to its co-subgeners, *viz.*, *X. perforator* F. SM., *X. tenuiscapa* WESTW., *X. magnifica* (CKLL.) and *X. latipes* (DRURY), but is quite distinct from any of them, being chiefly characterised by its sparse punctuation, its strongly elevated region between antennal fossae, its short III antennal segment, its wing-venation, its bright fulvous abdominal pubescence and the shape of its hypopygium.

Xylocopa perforator F. SM.

S p e c i m e n s E x a m i n e d: — SUMATRA: Medan, MJÖBERG, 1 ♂, 2 ♀ (Stockholm Mus.). — JAVA: Buitenzorg, KEMNER, 1 ♂ (Stockholm Mus.).

R e m a r k s. — From Semarang, Batavia and Buitenzorg (Java), FRIESE (Tijdschr. v. Ent., LVII, p. 7, 1914) has recorded both sexes of *X. tenuiscapa* WESTW.; from Timor Island, DUSMET (Trab. Mus. nac. Cienc. nat. Madrid, XLIX, p. 42, no. 69, 1924) and FRIESE (Rev. Suisse d. Zool. XLII, p. 295, 1935) respectively have recorded one female of the same; probably all these records are referring to *X. perforator* F. SM. since *X. tenuiscapa* is not an insect of the Sunda Islands.

Xylocopa latipes (DRURY).

1917. *Mesotrichia (Platynopoda) latipes* subsp. *basiloptera*, COCKERELL, Philipp. Jour. Sci., D, XII, p. 347 & 349, ♀.
1930. *Mesotrichia (Platynopoda) latipes* subsp. *basiloptera*, COCKERELL, Philipp. Jour. Sci., XLIII, p. 269.
1938. *Xylocopa (Platynopoda) latipes*, MAA, Rec. Indian Mus., XL, p. (in press).

For further bibliography, reference may be made to my other paper cited above.

V a r i a t i o n. — When COCKERELL (1917, *loc. cit.*) described his new subspecies *basiloptera* from Palawan, P.I., he has probably overlooked DRURY's illustration, in which the wings of this species are clearly shown in the following arrangement: area enclosed by cells bright bluish green, outer marginal area purple or reddish violet, extreme apical margin yellow-green. In some individuals, however, the purple iridescence is represented by greenish golden (sometimes with a little purplish tints), whilst the yellowish green at the extreme apical margin is represented by bright purple. But all these variations appear

to be merely individual aberrations and are possible due to the condition of preservation and so forth.

S p e c i m e n s E x a m i n e d. — MENTAWEI ISLANDS: Siberoet I., 23.IX.24, H. H. KARNY, 3 ♀; IX.24, C. BODEN KLOSS & N.S., 3 ♀. — Sipora I., 15.X.24, H. H. KARNY, 1 ♀. — SUMATRA: Asahan, Tangga, 2.VIII.28, 1 ♂, 1 ♀; Deli, Medan, 1 ♂, 9 ♀; Arnhemia, IV.28, 2 ♀; Asahan, Perdoeaän, 5.VIII.29, 2 ♀ (all J. C. VAN DER MEER MOHR). — Kota Tjane, 1 ♂; Tjima Poelos, 1 ♂; Sibolangit, 14 - 1500 m, 1 ♂ (all E. MJÖBERG, from the Stockholm Mus.). — Loeboek Sikaping, L. HUNDESHAGEN 450 m, 2 ♂, 6 ♀. — Atjeh, Pendeng, 200 - 400 m, II-III.37, 3 ♂, 2 ♀; Atjeh, Blangkedjeren, Lösten, III.37, 1 ♀; Atjeh, Pendeng, Gadjah, 400 - 1200 m, II.37, 1 ♀ (all A. HOOGERWERF). — Deli, Sibolangit, 1500 m, IX-X.29, W. M. DOCTERS VAN LEEUWEN, 1 ♂. — Fort de Kock, 920 m, E. JACOBSON, 1 ♂ (Dtsch., ent. Inst.). — Poeloe Berhala (off the E.-coast), VIII.27, J. C. VAN DER MEER MOHR, 1 ♀. — SEBESI I. (Strait Soenda), X.21, K. W. DAMMERMAN, 1 ♂ (det. ALFKEN). — JAVA: Mt. Gedeh, Selabintanah, 1000 m, XII.32, M. E. WALSH, 1 ♂; Mt. Gedeh, Tjiboenar Est., 1000 m, XI.29 F. C. DRESCHER, 1 ♂. — Bandoeng, 800 m, III.31, L. VAN DER PIJL, 1 ♂. — Buitenzorg, 250 m, 2.IX.20, 1 ♀; 22.IX.22, 1 ♀; W. M. DOCTERS VAN LEEUWEN; KEMNER, 12 ♀ (Stockholm Mus.). — Wijnkoopsbaai, KEMNER, 1 ♀ (Stockholm Mus.). — "Java", MELLERBORG, 1 ♀ (Stockholm Mus.). — Idjen Mts., Blawan, 950 m, V-VI.24, K. W. DAMMERMAN, 3 ♂, 1 ♀. — SOEMBA I.: Laora, 100 m, IV.25, K. W. DAMMERMAN, 1 ♀. — BORNEO (all from the Sarawak Mus.): Baram, X.10, 1 ♂. — Mt. Kinabalu, 2000 - 3000′, 24.IX.13, 1 ♀. — Matang, IX.06, 1 ♀. Kuching, 1 ♀. — Melawi (W. Borneo), BLANCHEMANCHE, XI-XII.24, 4 ♂ (Buitenzorg Mus.).

EINE NEUE *PACHYCEPHALA* VON DEN NORD-MOLUKKEN,

nebst einer Bemerkung über den Rassenkreis *Pachycephala pectoralis.*

Von

A. C. V. VAN BEMMEL

(Zoölogisch Museum, Buitenzorg).

Die Formen von *Pachycephala pectoralis* von Ternate, Halmahera, Batjan und Morotai wurden bis jetzt immer unter den Namen *Pachycephala* (*pectoralis*) *mentalis* WALL. zusammengefasst. Terra typica dieser Form ist Batjan (WALLACE: Proc. Zool. Soc. London 1863 p. 30). WALLACE stand auch ein Exemplar von Halmahera zur Verfügung das er offenbar in seiner Beschreibung miteinbezogen hat. Zwischen den Vögeln von Ternate und Tidore einerseits und den von den andern genannten Inseln andererseits besteht aber ein grosser Unterschied. Es ist m.E. deshalb notwendig beide Formen subspecifisch zu trennen.

Pachycephala pectoralis tidorensis, nov. subspec.

Typus: ♂ Tidore, 7-VII-1926. Cat. No. Zoöl. Museum Buitenzorg 4199.

Habitat: Tidore und Halmahera. Leg. ERIE.

Diagnose: Bedeutend grösser als *Pachycephala pectoralis mentalis.*

♂ gleich gefärbt wie *mentalis.* Das einzige zu meiner Verfügung stehende ♀ ist ein altes Exemplar aus der Sammlung VORDERMAN. Ich wage nicht zu entscheiden inwiefern die bedeutenden Farbenunterschiede zwischen diesem Stück und den frisch gesammelten Bälgen von *mentalis* durch Verfärbung durch Licht und Staub bedingt sind. Deshalb gebe ich von diesen Unterschieden keine Beschreibung. Nachfolgend gebe ich eine Uebersicht der Masse beider Subspecies.

tidorensis

Tidore: 1 ♂ Flügel 98 mm, Culmen 18,5 mm.

Ternate: 2 ♂♂ Flügel 99; 97 mm. Culmen 18; 18,5 mm.

1 ♀ Flügel 95 mm. Culmen 17,5 mm.

mentalis

Morotai: 1 ♂ Flügel 91 mm; Culmen 16 mm.

Batjan: 1 ♂ Flügel 88,5 mm; Culmen 16 mm (Topotype *mentalis*).

Halmahera 4 ♂♂ Flügel 95; 92; 89,5; 88,5 mm. Culmen 16; 15,5; 16; 15 mm.

2 ♀♀ Flügel 86,5; 85 mm; Culmen: 16; 15,5 mm.

Die Paratypen sind die beiden, von VORDERMAN in Natuurk. Tijdschr. Ned. Ind. 58, 1896 p. 214 beschriebenen Exemplare und eind Stück aus der Sammlung des Rijksmuseum voor Natuurlijke Historie Leiden, leg. BERNSTEIN, 2-V-1861.

VORDERMANS Beschreibung stimmt nicht ganz mit meinen Beobachtungen. So sind die von ihm gegebenen Flügelmasse bestimmt zu niedrig. Es ist mir nicht klar wie er zu diesen Werten gekommen ist. WALLACE (l.c.) gibt als Flügelmasse 3.7 inch. Das stimmt also etwa mit den von mir gefundenen Werten überein.

RENSCH (Mitt. Zool. Mus. Berlin 17, 1931, p. 583), scheidet *Pachycephala mentalis* von dem Rassenkreis *Pachycephala pectoralis* auf Grund der abweichenden Färbung der Weibchen. Die Subspecies *clio* von den Soela Inseln, Peleng und Banggai zeigt denselben Farbentyp wie es sich bei einem weiblichen Exemplar in der Sammlung des Zoologischen Museums Buitenzorg herausstellte. Diese Form nennt RENSCH aber wohl als Subspecies von *pectoralis*. Ich nehme an, dass er die ♀♀ von *clio* nicht gesehen hat.

Man könnte nun zwei Rassenkreise aufstellen, einer (*pectoralis*) dessen Weibchen eine mehr oder weniger einfarbige Unterseite besitzen, und ein anderer dessen ♀♀ eine quergestreifte Kehle haben. Letzterer würde dann die Subspecies *clio, mentalis, tidorensis* u.a. umfassen. Ich halte dies aber nicht für richtig. Wie ich an die von SIEBERS (Treubia VII Suppl. Fauna Buruana, Aves, 1930, p. 289 - 290) beschriebene Serie von *buruensis* HART. im Buitenzorger Museum beobachten konnte, stellt diese Form einen schönen Uebergang zwischen den beiden Farbentypen dar. Die ♀♀ sind hier an der Unterseite fast einfarbig, die etwas hellere Kehle zeigt jedoch eine verschwommene Querbänderung. Ich zögere dann auch nicht die obengenannten Formen in den Rassenkreis *Pachycephala pectoralis* mit einzubeziehen.

CERCOPIDES DU MUSÉE DE BUITENZORG (JAVA).

Par

le Dr. V. LALLEMAND

(Uccle).

Fam. CERCOPIDAE.

Sous-fam. Aphrophorinae.

Plinia ampla WALK. — Java occ.: Djampang Tengah, Mt. Tjisoeroe, 600 - 800 m, XI.1933 (M. E. WALSH); Palaboeanratoe, Tjipanas, 16-17.IV.1933 (M. A. LIEFTINCK). — Bornéo or.: Koetai, Long Petah, VIII-X.1925 (H. C. SIEBERS).

Plinia ampla WALK. var. *nigrifrons* SCHMIDT. — Java occ.: Djampang Tengah, Mt. Tjisoeroe, 6 - 800 m, III, IX, XI.1933 (M. E. WALSH).

Plinia pilosa DISTANT. — Bornéo or.: Koetai, Long Petah, 23.IX.-2.X.1925 (H. C. SIEBERS).

Plinia ineffecta WALK. — Bornéo or.: Koetai, Long Petah, 17.IX.1925 (H. C. SIEBERS).

Clovia conifera WALK. — Sumatra: Loeboek Sikaping, 450 m (L. HUNDESHAGEN). — Archipel Riouw: I. Doerian, VI.1923 (K. W. DAMMERMAN). — Java occ.: Buitenzorg, Bolang, 600 m, 11.V.1930 (M. A. LIEFTINCK). — I. Karimoen Djawa, P. Geléan, 22.XI.1930 (M. A. LIEFTINCK). — Bornéo or.: Koetai, Long Petah, 6.VIII.1925 (H. C. SIEBERS).

Clovia muiri LALL., n. sp. — Java occ.: Djampang Tengah, Mt. Tjisoeroe, 6 - 800 m, II.1935 (M. E. WALSH).

Clovia expressa WALK. — Sumatra: Deli, Sibolangit, 1400 m, 8.X.1926 (FULMEK & KARNY).

Clovia expressa WALK. var. *sumatrana* SCHMIDT. — Sumatra: Deli, Sibolangit, 1400 m, 8.X.1925 (FULMEK & KARNY); Medan: Soengei Krio, IV.1928 (J. C. VAN DER MEER MOHR).

Clovia sextaeniata SCHMIDT. — Java occ.: Djampangs, Soekanegara, 700 - 1000 m, 23-28.XII.1931; Depok, 2.II.1930 (M. A. LIEFTINCK).

Clovia scripta JAC. — Java or.: Mts. Idjen, Ongop-ongop, 1850 m, V.1924 (K. W. DAMMERMAN).

Clovia similis SCHMIDT. — Java occ.: Djampang Tengah, Mt. Tjisoeroe, 6 - 800 m, III.1933 (M. E. WALSH).

Thoodzata princeps DIST. — Java occ.: Mt. Gedeh, Tjibodas, 1400 m, VIII.1930 (M. A. LIEFTINCK).

Peuceptyelus sigilliferus WALK. — Java occ.: Djampang Tengah, Mt. Tjisoeroe, 6 - 800 m, III.1933 (M. E. WALSH). Java or.: Mts. Idjen, 1700 m, 25.V.1934 (K. W. DAMMERMAN).

Aphrophorias inclyta DIST. — Bornéo or.: Koetai, Long Petah, 26.VIII.1925 (H. C. SIEBERS).

Sous-fam. Cercopinae.

Considia transversa WALK. — Java occ.: Djampang Tengah, Mt. Tjisoeroe, 6 - 800 m, III, IV, IX, XI.1933 (M. E. WALSH).

Considia montana SCHMIDT. — Java occ.: Mt. Gedeh, Tjisaroea (Mt. Panggegerango), 1300 m, 2.VI.1932 (M. A. LIEFTINCK); Tjibodas, Tjibeureum, 1700 m, 30.VIII.1931 (M. A. LIEFTINCK).

Considia immaculata SCHMIDT. — Sumatra: Loeboek Sikaping, 450 m (L. HUNDESHAGEN). — Bornéo or.: Koetai, Long Petah, 17.IX.1925 (H. C. SIEBERS).

Keduscarta bicolora SCHMIDT. — Sumatra: Loeboek Sikaping, 450 m (L. HUNDESHAGEN).

Eoscarta liternoides BREDDIN. — Java occ.: Garoet, Kamodjang, Pateungteun, 1400 m, 19.IV.1930 (M. A. LIEFTINCK); Mt. Panggerango, Tjisaroea, 1050 m, 10.VIII.1930 (M. A. LIEFTINCK).

Aufidus lieftincki LALL., n. sp. — Nouvelle-Guinée sept.: riv. Mamberamo, Pionierbivak, I.1920 (W. C. VAN HEURN).

Suracarta tricolor tricolor LEP. SERV. — Sumatra: Loeboek Sikaping, 450 m (L. HUNDESHAGEN); Asahan, Halado, Tangga, 2.VIII.1928 (J. C. VAN DER MEER MOHR); Lampongs, Mt. Tanggamoes, 600 m, XII.1934 (M. A. LIEFTINCK). — Java occ.: Djampang Tengah, Mt. Tjisoeroe, 6 - 800 m (M. E. WALSH); Mt. Gedeh, Tjibodas, 1400 (M. A. LIEFTINCK); Mt. Panggerango, Sitoe Goenoeng, 100 m, 16.V.1937 (M. A. LIEFTINCK); Mt. Salak, 600 m, IV, X.1936; Mt. Pantjar, 500 m, VII-VIII.1936, III.1937 (F. DUPONT).

Suracarta tricolor rubroplagiata SCHMIDT. — Sumatra: Sibolangit, 1400 m, 8.X.1925 (FULMEK & KARNY), VII.1921 (W. DOCTERS VAN LEEUWEN).

Suracarta tricolor rubroplagiata SCHMIDT var. *bipunctata* SCHMIDT. — Sumatra: Deli, Sibolangit, 1400 m, 8.X.1925, et Bandar Baroe (FULMEK & KARNY).

Suracarta tricolor borneensis SCHMIDT. — Bornéo or.: Koetai, Long Petah, 29.VIII-23.X.1925 (H. C. SIEBERS).

Suracarta tricolor fasciata SCHMIDT. — Sumatra: Loeboek Sikaping, 450 m (L. HUNDESHAGEN). — Java occ.: Djampang Tengah, Mt. Tjisoeroe, 6 - 800 m, III-IV, XI.1933 (M. E. WALSH). — Bornéo occ.: Melawi, XI-XII.1924 (BLANCHEMANCHE).

Suracarta satanas SCHMIDT. — Bornéo or.: Koetai, Long Petah, 20.X.1925 (H. C. SIEBERS).

Simeliria viridans GUÉR. — Sumatra: Loeboek Sikaping, 450 m (L. HUNDESHAGEN). — Java occ.: Djampang Tengah, Mt. Tjisoeroe, 6 - 800 m, IX.1933 (M. E. WALSH); Mt. Salak, 600 m, I.1937 (F. DUPONT). — Lombok; Mt. Rindjani, 1400 m, IX.1936 (R. VAN DER VEEN).

Simeliria maxima LALL. — Sumatra: Loeboek Sikaping, 450 m (L. HUNDESHAGEN).

Ectemnonotum bivittatum AM. & SERV. — Java occ.: Mt. Pantjar, I.1937 (F. DUPONT); Mt. Gedeh, Selabintanah, 1000 m, II.1933; Djampang Tengah, Mt. Tjisoeroe, III, IX.1933 (M. E. WALSH); Palaboean Ratoe, Tjisolok, XII.1936.

Ectemnonotum buxtoni BUTL. — Sumatra mér.: Lampongs, Mt. Tanggamoes, 600 m, XII.1934 (M. A. LIEFTINCK).

Ectemnonotum buxtoni BUTL. var. *gracile* SCHMIDT. — Sumatra sept.: Atjeh, Pendeng, 400 m, III.1937 (A. HOOGERWERF).

Ectemnonotum simile SCHMIDT. — Java occ.: Djampang Tengah, Mt. Tjisoeroe, 6 - 800 m, IX-XI.1933 (M. E. WALSH).

Ectemnonotum acuminatum SCHMIDT. — Bornéo or.: Koetai, Long Petah, 28. IX.1925 (H. C. SIEBERS).

Ectemnonotum truncatum SCHMIDT. — Sumatra mér.: Lampongs, Mt. Tanggamoes, Giesting, 600 m, XII.1934 (M. A. LIEFTINCK).

Ectemnonotum spec. ?. — Bornéo or.: Koetai, Long Petah, 2.X.1925 (H. C. SIEBERS).

Homalostethus inexactus WALK. — Célèbes: Todjamboe, près de Palopo, 800 - 1000 m, 1936 (L. J. TOXOPEUS).

Homalostethus ochraceicollis SCHMIDT. var. — Célèbes mer.: VIII.1936 (L. J. TOXOPEUS).

Opistharsostethus rotundatus SCHMIDT. — Bornéo or.: Koetai, Long Petah, 10. X.1925 (H. C. SIEBERS).

Opistharsostethus divergens SCHMIDT (?). — Java occ.: Djampang Tengah, Mt. Tjisoeroe, 6 - 800 m, IX.1933 (M. E. WALSH).

Opistharsostethus javanensis SCHMIDT. — Java occ.: Djampang Tengah, Mt. Tjisoeroe, 6 - 800 m, IX.1933 (M. E. WALSH).

Opistharsostethus globosicollis SCHMIDT. — Bornéo or.: Koetai, Long Petah, 25. VIII.1925 (H. C. SIEBERS).

Ectemnonotops luridifulva SCHMIDT. — Sumatra occ., 1915 (B.S.). — Bornéo: Koetai, Long Petah, 20.VIII. & 2.X.1925 (H. C. SIEBERS).

Sialoscarta cavata WALK. — Java occ.: Mt. Salak, Goenoeng Boender, 1200 m, 25.XII.1929; Waroeng Loa, 9.II.1932; Bantam, Mt. Karang, 800 m, 27.V. 1931; Mt. Gedeh, Tjibodas, 1700 m, 28.III.1932; Djampangs, Soekanegara, 700 - 1000 m, 28.XII.1931 (M. A. LIEFTINCK).

Sialoscarta orientalis LALL., n. sp. — Peninsule malaise: Peralu, Jor Camp, 23.VIII.1932 (PENDLEBURY). — Bornéo or.: Koetai, Long Petah, 20.VIII.1925 (H. C. SIEBERS).

Trichoscarta similis SCHMIDT. — Java occ.: Mt. Tangkoeban Prahoe, Priangan, 1200 m, II.1934 (F. C. DRESCHER); Garoet, Kamodjang, 1400 m, 18.IV.1930 (M. A. LIEFTINCK).

Trichoscarta deianira BREDD. — Bornéo or.: Koetai, Long Petah, 20.VIII.1925 (H. C. SIEBERS).

Trichoscarta centrodes JAC. — Bornéo or.: Koetai, Long Petah, 27.VIII-30.IX. 1925 (H. C. SIEBERS).

Trichoscarta roborea DIST. — Sumatra or.: Palembang, Soeban Djerigi, 15.VI. 1933 (SOEKARNO).

Trichoscarta roborea deleta LALL., n. subsp. — Sumatra or.: Palembang, Soeban Djerigi, 15.VI.1933 (SOEKARNO).

Trichoscarta curvata LALL. — Bornéo or.: Koetai, Long Petah, 28.VIII.1925 (H. C. SIEBERS).

Trichoscarta apicalis JAC. — Nouvelle-Guinée sept.: riv. Mamberamo, Exploratie Bivak, ± 700 m, X.1926 (W. DOCTERS VAN LEEUWEN).

Phymatostetha lineata LALL., n. sp. — Bornéo or.: Koetai, Long Petah, 16.XI. 1925 (H. C. SIEBERS).

Phymatostetha borneensis BUTL. — Bornéo or.: Koetai, Long Petah, 4-11.X.1925 (H. C. SIEBERS).

Phymatostetha infuscata LALL. — Sumatra sept.: Atjeh, Pendeng, 400 m, II. 1937 (A. HOOGERWERF).

Phymatostetha malaisiana LALL., n. sp. — Sumatra: Loeboek Sikaping, 450 m, 1923 - 1927 (L. HUNDESHAGEN).

Phymatostetha circumducta WALK. forma *minuta*. — Bornéo or.: Koetai, Long Petah, 16.VIII.1925 (H. C. SIEBERS).

Phymatostetha dislocata WALK. — Sumatra: Loeboek Sikaping, 450 m (L. HUNDESHAGEN).

Phymatostetha dislocata WALK., var. — Sumatra mér.; Lampongs, Mt. Tanggamoes, 600 m, 5.VII.1934 (L. J. TOXOPEUS).

Phymatostetha fruhstorferi SCHMIDT. — Java centr.: Mt. Slamat, Batoerraden, 800 m, 19.X.1933 (M. A. LIEFTINCK); Mt. Tangkoeban Prahoe, 13 - 1600 m, II.1934 (F. C. DRESCHER).

Cosmoscarta dimidiata DALL. var. *eugeniae* BREDD. — Sumatra: Loeboek Sikaping, 450 m (L. HUNDESHAGEN); Palembang, Soengei Rambang, 25.V.1933 (SOEKARNO).

Cosmoscarta dimidiata DALL. var. *subapicalis* BREDD. — Sumatra: Fort de Kock, 900 m, II.1937 (E. JACOBSON); Loeboek Sikaping, 450 m (L. HUNDESHAGEN).

Cosmoscarta psecas BREDD. — Célèbes: Todjamboe, près de Palopo, VIII.1936 (L. J. TOXOPEUS).

Cosmoscarta spec. ?. — I. Komodo (près de I. Florès): VII.1937 (J. K. DE JONG).

Cosmoscarta apiana LALL. — Célèbes mér.: Mt. Lompobatang, VII.1936 (L. J. TOXOPEUS).

Cosmoscarta orchymonti LALL. — Célèbes: Todjamboe, près de Palopo, VII. 1936 (L. J. TOXOPEUS).

Cosmoscarta callizona longipennis LALL. n. subsp. — Célèbes mér.: VII.1936 (L. J. TOXOPEUS).

Cosmoscarta discrepans WALK. — Sumatra: Loeboek Sikaping, 450 m (L. HUNDESHAGEN); Palembang, Soengei Rambang, 25.V.1933 (SOEKARNO).

Cosmoscarta irresoluta WALK. — Java occ.: Djampang Tengah, Mt. Tjisoeroe, 6 - 800 m, III.1933 (M. E. WALSH).

Cosmoscarta liturata WALK. var. *sumbana* BREDD. — I. Soemba: Mao Marroe, 450 m, 1925; Laora, 100 m, IV.1925 (K. W. DAMMERMAN).

Gynopygolax submaculata WALK. var. *walkeri* LALL. — Java occ.: Djampang Tengah, Mt. Tjisoeroe, 6 - 800 m, IV, IX.1933 (M. E. WALSH).

Megastethodon urvillei LEP. & SERV. — Nouvelle-Guinée sept.: riv. Rouffaer, ± 175 m, VII.1926 (W. DOCTERS VAN LEEUWEN).

Megastethodon toricellanus JAC. — Nouvelle-Guinée sept.: Hollandia (GJELLERUP), Hollandia, V.1930 (W. STÜBER).

Megastethodon geniculata JAC. — Nouvelle-Guinée sept.: riv. Mamberamo, Motorbivak (Meervlakte), VIII.1926; Prauwenbivak; riv. Rouffaer, 1926, ± 175 m (W. DOCTERS VAN LEEUWEN); Pionierbivak, I.1920, Prauwenbivak, XI.1920, riv. Idenburg, 26-28.VIII.1920 (W. C. VAN HEURN).

Megastethodon wataikwensis DIST. — Nouvelle-Guinée sept.: riv. Memberamo, Prauwenbivak; Pionierbivak, I & II.1920 (W. C. VAN HEURN).

Megastethodon intermedius LALL., n. sp. — Sumatra mér.: Lampongs, Mt. Tanggamoes, 2100 m, 31.XII.1934 - 1.I.1935 (M. A. LIEFTINCK).

Megastethodon nasalis WALK. — Nouvelle-Guinée sept.: riv. Rouffaer, ± 175 m, VIII.1926 (W. DOCTERS VAN LEEUWEN).

Megastethodon nasalis WALK. var. ***lateralis*** LALL., n. var. — Nouvelle-Guinée occ.: Fak Fak, X.1923 (H. A. VAN MECKL).

Leptataspis nigripennis FABR. — Sumatra: Loeboek Sikaping, 450 m (L. HUNDESHAGEN).

Leptataspis costalis SCHMIDT. — Sumatra: Deli, Sibolangit, 1400 m, 8.X.1925 (FULMEK & KARNY).

Leptataspis concinna LALL., n. sp. — Java occ.: Buitenzorg, Perbakti, Mt. Salak, 1000 m, 20.VII.1922 (H. H. KARNY).

Leptataspis spec. ?. — Java occ.: Djampangs, Soekanegara, 700 - 1000 m, 28. XII.1931 (M. A. LIEFTINCK).

Leptataspis spec. ?. — Sumatra: Loeboek Sikaping, 450 m, 1926 (L. HUNDESHAGEN).

Leptataspis fuscipennis LEP. & SERV. — Java occ.: Mt. Karang, 600 m, 26.V. 1931 (M. A. LIEFTINCK); Buitenzorg, 250 m, III.1920 & XII.1934. Mt. Salak, 600 m, XII.1936 (M. A. LIEFTINCK); Mt. Gedeh, Selabintanah, 1000 m, II.1933; Djampang Tengah, 6 - 800 m, III-IV, IX-XI.1933 (M. E. WALSH).

Leptataspis angulosa STÅL. — Java occ.: Mt. Salak, 600 m, I.1937 (F. DUPONT); Mt. Salak, 800 m, 31.VII.1932 (M. A. LIEFTINCK). Mt. Gedeh, Selabintanah, 1000 m, II.1933 (M. E. WALSH); Djampang Tengah, Mt. Tjisoeroe, 6 - 800 m, IX.1933 (M. E. WALSH).

Leptataspis masoni DIST. — Bornéo or.: Koetai, Long Petah, 21.IX.1925 (H. C. SIEBERS).

Leptataspis ornata LALL., n. sp. — Nouvelle-Guinée sept.: riv. Rouffaer, ± 175 m, VIII.1926; Mt. van Rees (W. DOCTERS VAN LEEUWEN).

Leptataspis guttata LEP. & SERV. — Java occ.: Mt. Pantjar; Mt. Salak, 600 m, IV.1937 (F. DUPONT); Djampang Tengah, Mt. Tjisoeroe, 6 - 800 m, XI. 1933 (M. E. WALSH); Depok, 9.XI.1930 (M. A. LIEFTINCK).

Leptataspis guttatiformis SCHMIDT. — Java occ.: Djampang Tengah, Mt. Tjisoeroe, 6 - 800 m, III.1933 (M. E. WALSH); Palaboean Ratoe, Tjipanas, 16. IV.1933 (M. A. LIEFTINCK); Buitenzorg, Tjampea, XI.1936 (M. A. LIEFTINCK); Djampangs, Soekanegara, 700 - 10000 m, 23 - 28.XII.1931 (M. A. LIEFTINCK).

Leptataspis discolor BOISD., var. *quadripunctata:* I. Kei (Danske Exped. 1922), Papakoela, 22.IV.1922.

Leptataspis major JAC. — Sumatra: Loeboek Sikaping, 450 m (L. HUNDESHAGEN).

Leptataspis helena BREDD. — Sumatra sept.: Deli, Bandar Baroe, 9.X.1925 (H. H. KARNY); Habinsaran, Simanimbo, 1.VIII.1928 (J. C. VAN DER MEER MOHR); Coté occ., 1915 (B.S.).

Leptataspis cassandra BREDD. — Java occ.: Djampang Tengah, Mt. Tjisoeroe, 6 - 800 m, IX-XI.1933 (M. E. WALSH).

Leptataspis briseis BREDD. — Java occ.: Djampang Tengah, Mt. Tjisoeroe, 6 - 800 m, III.1933 (M. E. WALSH); Mt. Salak, 1000 m, Tjitjoeroek, 23.I.1922 (H. H. KARNY); Mt. Gedeh, Selabintanah, 1000 m, II.1933 (M. E. WALSH).

Leptataspis perakensis LALL. — (Mal. Branch Roy. As. Soc. 1923, p. 270). — Sumatra sept.: Atjeh, Pendeng, 400 m, I.1937 (A. HOOGERWERF).

Leptataspis sempolana LALL. (Rev. Suisse Zool. 42, 1935, p. 680). — Java or.: Idjen, Blawan, 950 m, VI.1924 (K. W. DAMMERMAN).

Leptataspis lutea SCHMIDT. — Java occ.: Djampang Tengah, Mt. Tjisoeroe, 6 - 800 m, III.1933 (M. E. WALSH).

Leptataspis polyxena BREDD. — Sumatra mér.: Lampongs, Mt. Tanggamoes, 600 m, XII.1934 (M. A. LIEFTINCK).

Clovia mutri, n. sp.

Voisin de *C. lemniscata* STÅL et *C. sextaeniata* SCHMIDT, même coloratien du corps et même disposition des bandes transversales du vertex et du pronotum, qui sont brunes au lieu d'être noires. La plus grande partie du clavus et la région du corium voisine de la suture sont ocre brun clair; partie apicale jaune; sont noirs: 1e. une bande longitudinale partant de la base, s'enflant au milieu et bordant en avant et en dehors la bande jaune antérieure; 2e. un V médian, dont la branche antérieure s'étend sur le clavus, où elle pâlit et devient brune, et la postérieure s'étend jusque la pointe du clavus; 3e. une bande oblique partant du bord externe et arrivant légèrement en arrière de l'angle apical, non loin du bord; 4e. une ligne transversale partant de la dernière bande et atteignant la pointe du clavus; 5e. enfin perpendiculairement à cette ligne transversale, deux ou trois autres se dirigeant vers l'arrière. Une fine bande brune à la partie apicale du bord externe. La bande jaune antérieure part du bord

externe en avant du milieu, s'étend en avant et en dedans jusque la nervure externe du clavus, là elle se coude brusquement et va en se retrécissant vers la base où elle rejoint l'extrémité de la bande médiane du pronotum. Vertex un peu plus long et plus aigu que celui de *C. lemniscata.*

Longueur: 8 à 8,5 mm.

Habitat. — Java: „Banderajo" (MUIR); Mt. Gedeh, 1898 (H. FRUHSTORFER); Soekaboemi (LE MOULT); Mt. Moeria; Djampang Tengah, G. Tjisoeroe, 6 - 800 m, II.1933 (M. E. WALSH).

Type: ma collection; paratypes: collection du Musée de Buitenzorg et la mienne.

Aufidus costalis, n. sp.

Vertex, pronotum, et écusson: brun noir; partie frontale du vertex, sur certains exemplaires, cinq petites taches situées en arrière du bord antérieur du pronotum, base et extrémité de l'écusson: brun plus clair; ocelles jaunâtres; bords latéraux et extrémité de l'écusson jaune brun; élytres brun noir, opaques vers la base, transparents et plus bruns dans la partie postérieure; au bord externe, en avant du tiers apical, une tache blanche, hyaline, allongée, triangulaire, qui s'étend jusqu'au radius; front, labre, rostre, sternum, abdomen et pattes: ocres; sternum et abdomen bordés de chaque côté de brun noir; organes génitaux ocres et brun noir; extrémité des tarses brun noir; ailes enfumés à nervures brun noir; sur la face supérieure de l'insecte une villosité rousse, abondante. Fossette des tibias antérieurs occupant leur moitié inférieure, mais ne s'étendant pas jusqu'à leur extrémité; pronotum fortement ponctué en lignes transversales; de deux à quatre nervures entre la branche externe du radius et le bord externe; une épine sur les tibias postérieurs; front presque plan dans sa partie médiane, la fossette étant très peu profonde. Comme coloration, cette espèce est très voisine de *A. hopkinsi* LALL., mais la forme et les dimensions de la tache des élytres sont différentes, elle est moins grande et moins large.

Longueur: 6 mm.

Habitat. — Larat (F. MUIR).

Type: ma collection.

Paratypes: Collection du Musée de Buitenzorg (une) et la mienne.

Aufidus lieftincki, n. sp.

Tête, pronotum, écusson et base des élytres: oranges; sur le vertex, entre les yeux, une bande noire; chez la ♀ le bord antérieur de la partie frontale du vertex et la partie supérieure du milieu du front sont également noires, tandis que chez le ♂, seul le bord antérieur de la partie frontale est brun noir; premier article du rostre, sternum, pattes: ocres; antennes, second article du rostre: brun noirâtre; partie externe des tibias antérieurs brune; tarses antérieurs et médians, ainsi que le dernier article des tarses postérieurs: brun noir; abdomen brun; élytres opaques sur un peu moins que la moitié basale, transparents sur

le restant, la partie opaque est orange à la base, puis noire; cette dernière couleur la plus étendue à son bord antérieur en angle dont la pointe est comprise entre la suture et la nervure interne du clavus; la partie transparente est d'abord blanche et hyaline, puis brune; les nervures sont saillantes et de la même couleur que la région qu'elles occupent, sauf sur la partie hyaline où elles sont jaunâtres; ailes légèrement enfumées. Le médian et le cubitus se séparent à la fin du quart antérieur, le radius se bifurque au niveau de l'extrémité du clavus, entre sa branche externe et le costa se trouvent trois nervures transversales; la fossette des tibias antérieurs est égale au tiers de leur longueur.

Longueur: 8 à 8,5 mm.

Habitat. — Nouvelle Guinée sept., riv. Mamberamo, Pionierbivak, I. 1920 (W. C. van Heurn).

Type: Collection du Musée de Buitenzorg.

Sialoscarta orientalis, n. sp.

Tête noire, sauf le clypéus et le rostre; pronotum jaune sur les $^2/_5$ antérieurs et noir sur le restant; écusson orange traversé d'une bande noire; corps orange; paratergites, organes génitaux, tibias et tarses antérieurs et médians, noirs; tibias et dernier article des tarses postérieurs bruns; élytres hyalins à base orange et à nervures noires bordées de noir brunâtre; le long du bord costal une bande noire, étroite d'abord et s'élargissant progressivement vers l'extrémité.

Long. 10 mm.

Habitat: Bornéo oriental: Koetai, Long Petah, 20.VIII.1925 (H. C. Siebers) Péninsule malaise: Péralu, Jor Camp, 23.VIII.1922 (Pendlebury).

Ci-dessous, une table dichotomique des différentes espèces actuellement connues du genre *Sialoscarta* Jac.:

1 a) Elytres à péu près transparents, jaunâtres ou brunâtres, à nervures concolores. 2

b) Elytres hyalins, à bord costal noir, les nervures foncées. 5

2 a) Pronotum noir à bande antérieure orange ou rougeâtre; tout le front et les $^2/_3$ antérieurs du clypeus, noirs; mésosternum brun (Java).
S. cavata Walk.
(= *concinna* Jac.).

b) Pronotum jaune ou brun; front non entièrement noir. 3

3 a) Pronotum ambre jaune, à bande d'un jaune plus vif sur le tiers antérieur; tiers inférieur du front, clypeus et mésosternum jaunes (Sumatra).
S. sumatra Schmidt.

b) Pronotum brun, plus foncé immédiatement en arrière de la bande orange; front orange (Bornéo). 4

4 a) Taille 11 mm; à la partie supérieure du front une bande transversale noire.
S. kinabaluensis Lall. (*Aufidus*).

b) Taille 6,5 mm à 7 mm; pas de bande noire à la partie supérieure du front.
S. minuta Lall. (*Aufidus*).

5 a) Bord costal noir brillant jusqu'au stigma, qui est jaune ou blanc jaunâtre; nervures brunes; en arrière du stigma, une tâche brun noirâtre s'étendant vers l'intérieur; vertex noir, partie frontale du vertex, front et clypéus jaune soufre (chez la ♀, une tâche longitudinale noire, sur la partie médiane supérieure au front); abdomen noir (les côtés des segments jaunes) (Sumatra, Bornéo). .... *S. krugeri* SCHMIDT. (= *matanga* DIST.).

b) Bord costal noir jusqu'à l'extrémité de l'élytre; nervures noires bordées de noir brunâtre; tête entièrement noire; abdomen jaune (les côtés des segments noirs) (Bornéo oriental). .... *S. orientalis* LALL.

Trichoscarta roborea deleta, n. subsp.

Brun foncé; sont jaune orange très légèrement brunâtre: les plaques jugales, une bande médiane longitudinale occupant le vertex et la partie supérieure du front, la bande transversale du pronotum, qui se prolonge le long des bords latéro-antérieurs, ainsi que la carène longitudinale de ce dernier dans sa partie tout-à-fait antérieure (un mm environ); sur les élytres, au-devant de la partie réticulée, deux taches blanc jaunâtre, assez grosses et assez écartées l'une de l'autre.

Longueur: 17 mm.

Habitat. — Sumatra: Palembang, Soeban Djerigi, 18.V.1933 (SOEKARNO).

Type: collection du Musée de Buitenzorg.

Tr. vittata SCHMIDT doit être aussi une sous-espèce de *roborea* DIST.

Phymatostetha malaisiana, n. sp.

Noire; sont jaune pâle: une tache en pointe de flèche à la partie supérieure du front, le labre, le premier article du rostre, le thorax, la face inférieure de l'abdomen, la plus grande partie des pattes, une bande le long de chaque bord du pronotum, la base du corium et du clavus, ainsi que deux bandes transversales sur les élytres. La couleur jaune de la base du corium s'étend en pointe, un peu en arrière, le long du bord costal; sur des exemplaires provenant de Sélangor, la première bande a, en grande partie, disparu; le front est noir, noir brun ou ocre brun; la bande jaune du bord antérieur du pronotum est moins large que celle des autres bords. Une tache à la base des hanches antérieures, une sur chaque côté du mésosternum, les protubérances, trois taches (une grosse médiane et deux petites latérales) sur chaque segment de la face inférieure de l'abdomen, une ligne sur les cuisses; l'extrémité des tibias, les tarses antérieurs et médians, l'extrémité des articles de tarses postérieurs sont noirs. Une tache brune sur chaque côté du métasternum.

Protubérances du mésothorax en cônes fort émoussés, sans pointe saillante; le médian et le cubitus sont soudés l'un à l'autre sur un trajet assez court; le radius se bifurque un peu en avant du tiers postérieur du corium; le pronotum est assez fortement et grossièrement ponctué, et montre une faible carène médiane.

Longueur: 11 mm.

H a b i t a t. — Bornéo (XANTUS). — Sumatra: Loeboek Sikaping, 450 m (L. HUNDESHAGEN).

Péninsule malaise: Sélangor, Bukit Kutu, 22.IX.1933 (H. M. PENDLEBURY).

T y p e: ma collection. Paratypes: Collection du Musée de Buitenzorg (1 de Sumatra), et de Kuala Lumpur.

Phymatostetha lineata, n. sp.

Noire; lobes latéraux et partie frontale du vertex, partie supérieure du front, une assez large bande le long des bords latéro-antérieurs du pronotum: blanc jaunâtre; sur les deux tiers antérieurs du clavus, une bande médiane, sur le corium, deux bandes longitudinales occupant les $^3/_4$ antérieurs, sur le $^1/_4$ postérieur une assez grande tache médiane: rouge brique; les deux bandes du corium sont séparées par une autre médiane, noire, inégale, étroite près de la base, et qui s'élargit fortement au niveau de la séparation du médian et du cubitus. L'insecte est recouvert d'une villosité rousse, dense.

Pronotum fortement ponctué et strié, une carène bien marquée dans sa moitié antérieure; protubérances thoraciques très saillantes en un cône assez effilé; médian et cubitus réunis sur un trajet assez court.

Longueur: 20 mm.

H a b i t a t. — Bornéo or.: Koetai, Long Petah, 16.XI.1925 (H. C. SIEBERS).

Phymatostetha fruhstorferi SCHMIDT.

Sur un des exemplaires les deux taches antérieures des élytres, voisines de la suture, sont réunies au crochet qui termine la bande longitudinale costale et forment une bande complète, à concavité antérieure; de même les deux taches postérieures se rejoignent et constituent une bande transversale occupant la moitié de la largeur.

Cosmoscarta callizona longipennis, n. subsp.

Comme coloration et dessin cette sous-espèce est presque identique à l'espèce, les bandes transversales des élytres sont un peu plus claires, d'un blanc jaunâtre, et le bord postérieur lui-même du prononum est noir, au lieu d'être de la couleur de la bande; ce qui la distingue surtout c'est la longueur des élytres, elle est de 17 mm, tandis que chez *C. callizona* elle n'est que de 14 mm; la distance qui sépare la seconde bande du bord apical est aussi proportionnellement plus grande (7 mm et 4 mm); à la face inférieure, les segments abdominaux sont bordés en arrière d'une large bande rouge brique pâle.

Longueur totale 20 mm; long. du corps: 15 mm; élytres: long.: 17 mm, larg.: 6 mm.

H a b i t a t — S.O. Célèbes, VII.1936 (L. J. TOXOPEUS).

Megastethodon intermedius, n. sp.

Noir mordoré, brillant, sauf: les yeux gris clair, les ocelles jaunes, à la base des élytres le subcosta jaune brunâtre ou rouge carmin, les hanches, les

pattes, les bords latéraux et postérieurs des segments abdominaux, ainsi que sur chacun d'eux une ligne médiane longitudinale, qui sont rouge carmin; les cuisses dans leur partie externe et l'extrémité des tarses sont noirâtres; organes génitaux et rostre: rouge carmin plus ou moins teinté de brun; nervures dans la moitié postérieure des élytres rouge grenat foncé, cette coloration est surtout visible par transparence; sur le pronotum, l'écusson et les élytres, une forte villosité rousse.

Protubérances thoraciques fortes, coniques, légèrement dirigées en avant, le bord postérieur en est rapproché et peu élevé; sur les élytres, le médian et le cubitus sont soudés vers la base, sur une assez faible longueur et à la partie postérieure apicale entre ceux-ci pénètre le réseau apical; angles scapulaires du pronotum saillants; ocelles très gros, rapprochés, plus près l'un de l'autre que des yeux.

Ce cercopide rappelle à première vue les espèces du genre *Simeliria* SCHMIDT, dont il a la forme et la coloration générale, il s'én distingue par la conformation des protubérances du mésothorax, et du pronotum.

Longueur: 24 mm; élytres: long.: 20 mm, larg: 6 mm.

H a b i t a t. — Sumatra mér.: Lampongs, Mt. Tanggamoes, 2100 m, 31.XII. 1934 — 1.I.1935 (M. A. LIEFTINCK).

T y p e et 1 paratype: Collection du Musée de Buitenzorg.

Megastethodon nasalis WLK. var. ***lateralis,*** n. var.

Différencie par les bords du pronotum qui sont oranges.

H a b i t a t. — Nouvelle-Guinée occ.: Fak Fak, X.123 (H. A. VON MECKL).

T y p e: Collection du Musée de Buitenzorg.

Leptataspis concinna, n. sp.

Tête, pronotum, écusson: brun noir, brillants; bords latéraux du pronotum ocres; ocelles blanc jaunâtre; élytre ocre jaune, à taches noires, sur les deux tiers antérieurs et bruns à nervures ocre jaune, sur le tiers postérieur; sur la partie antérieure, neuf taches, dont une près de la base et les autres disposées en deux rangées de 4: 6 sur le corium et 2 sur le clavus, ces 2 dernières peuvent elles-même être partagées en 2 par la nervure longitudinale; ailes enfumées; pro- et mésosternum brun très clair; rostre, métasternum, abdomen: ocre jaune taché de brun clair; pattes ocre jaune, légèrement foncées vers l'extrémité des tibias, épines et poils noirâtres.

Ocelles très gros, à distance égale l'un de l'autre et des yeux; pronotum lise, brillant, à carène médiane at à grandes fossettes en arrière des yeux; 3 fossettes sur l'écusson, qui est transversalement strié; rostre dépassant tres légèrement les hanches médianes; une seule épine sur les tibias postérieurs; à la partie apicale des élytres, les cellules sont très grandes et peu nombreuses, une nervure périphérique court parallèlement au bord postérieur; bord de la tête, vue de côte, en angle droit.

Longueur totale: 12 mm; élytres: long.: 10 mm; larg.: 3 mm.

Habitat. — Java occ., Mt. Salak, Perbakti, 1000 m, 20.VII.1922 (H. H. KARNY).

Type: ma collection; paratypes: collection du Musée de Buitenzorg (1) et la mienne.

Leptataspis ornata, n. sp.

Tête rouge; pronotum noir au milieu, du bord antérieur au postérieur, de chaque côté, une large bordure rouge; écusson brun noir, à extrémité parfois rouge; élytres rouges sur les $^2/_3$ antérieurs et noirs sur le $^1/_3$ postérieur; sur la partie antérieure, une tache voisine de la base et ensuite une bande transversale, atteignant le bord interne mais pas l'externe; au milieu de la partie postérieure noire une grosse tache rouge; rostre, sternum, abdomen, pattes: brun noir; bords latéraux des pro- et mésosternum rouges; genou des pattes postérieures rougeâtre; yeux tachés de brun noir.

Ocelles à égale distance l'un de l'autre et des yeux; pronotum brillant, assez lisse, à faible carène médiane; une grande fossette centrale sur l'écusson; rostre s'étendant jusqu'entre les hanches médianes; 2 épines sur les tibias postérieurs, une très faible à la base, une très forte vers l'extrémité; tête, vue de côté, arrondie.

Longueur totale: 18 mm; élytres: long.: 15 mm; larg.: 5 mm.

Habitat: Nouvelle-Guinée sept.: Mont Van Rees, 300 m, riv. Van Gelderen (W. DOCTERS VAN LEEUWEN); riv. Rouffaer, 175 m, VIII.1926 (1) W. DOCTERS VAN LEEUWEN).

Type: ma collection; paratypes: Collection der Musée de Buitenzorg (1) et la mienne.

SOME NEW OR RARE FISHES OF THE INDO AUSTRALIAN ARCHIPELAGO VII [1]

by

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Fam. AULOSTOMATIDAE.

AULOSTOMA Lacépède.

Aulostoma valentini (Blkr.).

D.XII.26; A.IV.24; P.17; V.6.

Elongate and impressed; height 13 in length without caudal [2]), 7 in head. Head with snout very compressed, 3 in length. Snout 1.5 in head. Eye more than 8 in snout. Lower jaw longer than upper. Chin prominent with a rather stiff barbel, which is about as long as eye. Operculum, neck and lower part of snout with conspicuous striae. Soft dorsal posterior. The distance from the origin of the soft dorsal to origin of caudal about equal to snout. Anal equal to soft dorsal and opposite to it, its longest ray somewhat less than twice in its length. Pectorals short, rounded about twice the diameter of the eye. Length of ventrals 1.5 diameter of eye. Its base midway between frontborder of eye and base of caudal. Caudal rounded, its length 2.5 the diameter of the eye. Scales small, rather strongly ctenoid. Head naked. Longitudinal brownish bands from operculum to end of dorsal. On caudal peduncle a few faint crossbars. The lowermost longitudinal band from below the pectorals through base of ventrals to origin of anal where the right and left one become confluent. It is continued along the base of the anal where it is much darker brown as anteriorly. The second longitudinal band from base of pectoral to end of base of anal. Third and fourth longitudinal bands from operculum to a point on lateral line just between ends of anal and soft dorsal. They become confluent between the origin of anal and of dorsal. The lowermost one of the two is divided into two narrow bands just above origin of ventrals, the upper one is divided into two narrower ones halfway between origin of ventrals and origin of dorsal. The fifth and sixth (uppermost) bands become confluent below origin of dorsal. Anterior half of base of dorsal black. Two black dots on base of anal. A black line on maxillary as well as before eye.

One specimen with a total length of 54 cm. Bay of Batavia February 1937.

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[1]) Cf. Treubia XIII, p. 411; XIV, p. 215; XIV, p. 131; XV, p. 367; XVI, p. 311.

[2]) With length is always meant the length of head and body, with the caudal fin excluded.

Litterature:
1. *Polypterichthys valentini* BLEEKER, Nat. Tijdschr. Ned. Indië IV, 1853, p. 608.
2. *Aulostoma chinense* GÜNTHER, Cat. Brit. Mus. 1859 - 1861, p. 538.
3. *Aulostoma chinense* BLEEKER, Ned. Tijdschr. Dierk. I, 1863, p. 235.
4. *Aulostoma valentini* JENKINS, Bull. U.S. Fish Comm. XXII, (1902) 1904, p. 437.
5. *Aulostoma valentini* JORDAN and EVERMANN, ibid. XXIII, (1903) 1905, p. 114.
6. *Aulostoma valentini* MAX WEBER, Siboga-Exped. Fische 1913, p. 100.
7. *Aulostoma chinensis* JORDAN, TANAKA & SNYDER, Journ. Coll. Sc. Univ. Tokyo XXXIII, 1913, p. 103.
8. *Aulostoma valentini* WEBER and DE BEAUFORT, Fishes of the Indo-Australian Archipelago IV, 1922, p. 10.
9. *Aulostoma chinensis* FOWLER, Fishes of Oceania 1928, p. 116.
10. *Aulostoma valentini* BARNARD, Fishes of South Africa 1927, p. 272.

Fam. SOLENOSTOMIDAE.

SOLENOSTOMUS LACÉPÈDE.

Solenostomus cyanopterus BLKR.

D.V.8; A.18; P.27; V.7.

Height 8 in total length (caudal included), head about 3. Eye 9 - 10 in head, more than twice in postorbital part. Length of snout 3 in length without caudal. Caudal peduncle as high as long. Membrane of the caudal beginning rather near the dorsal and anal. Dorsal and anal inserted on half circular elevations, which together are as high as height of body behind pectorals. Height of spinous dorsal about 1.5 in snout, its base somewhat behind ventrals. Ventrals somewhat longer as spinous dorsal. Pectoral rays short, about as long as eye. No barbel at mandibular symphysis. Skin osseous with rather feeble spines in three rows on body. Colour brownish with scattered small black spots. Spinous dorsal ventrals and caudal blackish. Soft dorsal, anal and pectorals transparent.

Four specimens from the South Coast of Bali (den Pasar, leg. Mr. NEUMANN), 2-10-'37. Largest one (which is described here) 100 mm.

Litterature:
1. *Solenostoma paradoxum* BLEEKER, Nat. Tijdschr. Ned. Indië III, 1852, p. 308, (nec. PALLAS).
2. *Solenostoma paradoxum* BLEEKER, Verh. Bat. Genootsch. XXV, 1853, Bijdr. Troskieuwige Visschen p. 29 (nec. PALLAS).
3. *Solenostoma cyanopterus* BLEEKER, Nat. Tijdschr. Ned. Indië VI, 1854, p. 507.
4. *Solenostoma cyanopterus* BLEEKER, Nat. Tijdschr. Ned. Indië VIII, 1855, p. 434.

5. *Solenichthys cyanopterus* BLEEKER, Ned. Tijdschr. Dierk. II, 1865, p. 183 - ibid p. 273.
6. *Solenostoma cyanopterum* PLAYFAIR & GÜNTHER, Fishes Zanzibar 1866, p. 137.
7. *Solenostoma cyanopterum* GÜNTHER, Cat. Brit. Mus. VIII, 1870, p. 151.
8. *Solenostomichthys cyanopterus* BLEEKER, Ned. Tijdschr. Dierk. IV, 1873, p. 126.
9. *Solenostomus cyanopterus* JORDAN & EVERMANN, Bull. U.S. Fish Comm. XXIII, (1903) 1905, p. 118.
10. *Solenostomus cyanopterus* MAX WEBER, Siboga-Expedition, Fische 1913, p. 104.
11. *Solenostomus cyanopterus* WEBER and DE BEAUFORT, Fishes of the Indo-Australian Archipelago, IV, 1922, p. 26.
12. *Solenostomus cyanopterus* BARNARD, Fishes of South Africa, 1927, p. 28.
13. *Solenostomus cyanopterus* FOWLER, Fishes of Oceania, 1928, p. 109.

Fam. **BOTHIDAE.**

PSEUDORHOMBUS BLEEKER.

Pseudorhombus affinis M. WEB.

D.73; A.51; P. sin 2.9.1; P. dextr. 11; V.24; L.l.76.

Dorsal profile somewhat more arched than ventral. Height 2 in length without caudal, 2.3 with caudal included. Head 3.6 in length, 4.4 in length with caudal. Eye 6 in head, about 1.5 in snout. Eyes separated by a rather low bony ridge. Eyes above each other, equal in length. A row of small canines in both jaws. Maxillary reaching to below about the middle of the eye, 2.3 in head with a few scales on coloured side. Origin of dorsal beginning on blind side above anterior nostril. A line through origin of dorsal and posterior nostril does not reach the maxillary. Origin of ventral below origin of pectorals. No preanal spine. All anal and dorsal rays simple. The subposterior rays are slightly longer than the others. Scales ctenoid on coloured side, cycloid on blind side, covering head with exception of snout. Forward prolongation of lateral line reaches upper profile at 10th dorsal ray. Left pectoral somewhat longer than postorbital part of head, right pectoral much shorter. Ventrals somewhat shorter than eye and snout together. Caudal obtusely pointed. Colour darkbrownish with three faint blackish spots on lateral line. More blotches on several parts of the body are faintly to be seen. Body and fins widely covered with small black spots.

One specimen with a total length of 28 cm. Fishmarket of Dolo (Aru Islands). November 1937.

Litterature:

1. *Pseudorhombus affinis* MAX WEBER, Siboga Exp., Fische 1913, p. 426.

2. *Pseudorhombus affinis* WEBER and DE BEAUFORT, Fishes of the Indo-Australian Archipelago V, 1929, p. 110.

Fam. **CHAETODONTIDAE.**

HEMITAURICHTHYS BLEEKER.

Hemitaurichthys zoster (BENNETT).

D.XII.25; A.III.21; L.l.74; L.tr.14-1-33.

Strongly compressed, orbicular, dorsal profile more convex than ventral, especially anteriorly. Rostrodorsal profile with a concavity above snout. Height 1.5 in length without caudal. Head 3 in length. Eye about 4 in head, more than once in postorbital part, situated just above the horizontal through commencement of gape of mouth. The eye is somewhat smaller than interorbital space. Praeoperculum with an almost rectangular finely serrated hindborder. Mouth terminal, small, with fine brushlike teeth. Scales small, somewhat decreasing on head and on caudal peduncle, continued as a sheath on base of anal and of soft dorsal. Lateral line strongly arched. Spinous dorsal with an incomplete membrane. Base of soft dorsal about as long as base of anal and as long as base of spinous dorsal without the three anterior spines. Spines of spinous dorsal strong, the highest in the middle, 1.7 in head and somewhat longer than spines of anal. Pectorals somewhat longer than head and somewhat shorter than ventrals, which end into a filament. Caudal very slightly concave, least height of its peduncle 2.8 in eye. Head, breast, anterodorsal part of body and dorsal and anal yellow. Remainder of body and pectorals, ventrals and caudal greyish. The yellow of the head is partly covered with brown. Snout blackish.

One specimen with a total length of 130 mm from a reef in the western part of the Java Sea 1938.

Litterature:

1. *Chaetodon polylepis* BLEEKER, Act. Soc. Sc. Indo-Neerl. II, 1857, p. 54.
2. *Chaetodon zoster* GÜNTHER, Cat. Brit. Mus. II, 1860, p. 33.
3. *Tetragonopterus zoster* BLEEKER, Ned. Tijdschr. Dierk. I, 1863, p. 270.
4. *Hemitaurichthys polylepis* BLEEKER, Arch. Néerl. Sc. Nat. XI, (1875) 1876, p. 304. — Versl. Akad. Amsterdam (2) X, 1876, p. 316.
5. *Hemitaurichthys polylepis* BLEEKER, Verh. Akad. Amsterdam XVII (1876) 1877. Rév. Chétodont. p. 50. Atl. Ichth. IX, 1877, p. 31. — Arch. Néerl. Sc. Nat. XIII, 1878, p. 44.
6. *Hemitaurichthys polylepis* HERRE & MONTALBAN, Philippine Journ. Sci. 1927, p. 73.
7. *Hemitaurichthys zoster* FOWLER, Fishes of Oceania, Bishop Mus. X, 1928, p. 257.
8. *Hemitaurichthys zoster* WEBER and DE BEAUFORT, Fishes of the Indo-Australian Archipelago VII, 1936, p. 25.

CHAETODON L.

Chaetodon (Citharoedes) ornatissimus C. V.

D.XII.25; A.III.20; L.l. ± 50; L.tr.10-1-22.

Compressed, oval. Height 1.5 in head, 3.4 in length. Rostrodorsal profile obliquely ascending in a nearly straight line. A concavity before the eyes. Eyes 4 in head, situated high above horizontal through gape of mouth, almost totally in anterior half of head, about twice in strongly convex interorbital space. Snout bluntly rounded about 1.5 the diameter of the eye. Praeoperculum very finely denticulated. Several rows of fine setiform teeth in anterior part of jaws. Scales rounded, moderate, smaller on head, chest and unpaired fins. Scales on trunk in regular longitudinal and transverse series. Lateral line arched, parallel with dorsal profile till last dorsal spine, hence deflected towards termination of dorsal but ending before it. Spinous dorsal longer than soft. First spine stronger than soft. First spine stronger than second about as long as eye, last spine somewhat shorter than head without snout. Soft dorsal rounded, obtusely angulate in its last part. Anal spines strong, second one somewhat longer than half of head. Soft anal rounded. Pectorals subequal, about as long as head without snout. Candal somewhat rounded. Least height of caudal peduncle more than twice in head. Colour of alcoholspecimen yellowish. Head with six transverse black bands. First on lower lip. Second around snout. Third through the eye from isthmus to front, not so broad as eye. Fourth across praeoperculum and continued along margin of sheath of dorsal. Fifth, much narrower, across front-border of operculum, sixth along hindborder of operculum. Body with six oblique longitudinal bands reaching medium fins. On dorsal and anal a black band below margin, then follows a whitish band, whilst the border is black again. On the caudal the same two black bands with the whitish interspace, but the outer black band is submarginal.

One specimen, total length 17 cm. From a coral reef in the western part of the Java Sea.

Litterature:

1. *Chaetodon ornatissimus* CUVIER & VALENCIENNES, Hist. nat. Poiss. VII, 1831, p. 32.
2. *Chaetodon ornatissimus* BLEEKER, Act. Soc. Sc. Indo-Néerl. II, 1857, Ambon p. 55.
3. *Chaetodon ornatissimus* GÜNTHER, Cat. Brit. Mus. II, 1860, p. 15.
4. *Tetragonopterus ornatissimus* BLEEKER, Ned. Tijdschr. Dierk. II, 1865, p. 286.
5. *Chaetodon ornatissimus* GÜNTHER, Fische der Südsee, 1873 - 75, p. 38.
6. *Tetragonopterus (Citharoedus) ornatissimus* BLEEKER, Verh. Akad. Amsterdam XVII, (1876) 1877, Chétodont. p. 57-Atl. Ichth. IX, 1877, p. 32.
7. *Chaetodon ornatissimus* SEALE, Occas. Papers Bishop Mus. I, 1901, p. 100.
8. *Chaetodon ornatissimus* JORDAN & SEALE, Bull. Bur. Fish XXV (1905) 1906, p. 345.

9. *Chaetodon ornatissimus* JORDAN & EVERMANN, Bull. U.S. Fish. Comm. XXIII, (1903) 1905, p. 373.
10. *Chaetodon ornatissimus* HERRE & MONTALBAN, Philippine Journ. Sci. XXXIV, 1927, p. 42.
11. *Chaetodon ornatissimus* FOWLER, Fish. Oceania Bishop. Mus. X, 1928, p. 243.
12. *Chaetodon* (*Citharoedus*) *ornatissimus* WEBER and DE BEAUFORT, Fishes of the Indo-Australian Archipelago VII, 1936, p. 71.

Fam. LUTJANIDAE.

SCOLOPSIS CUVIER.

Scolopsis xenochrous GTHR.

D.X.9; A.III.7; P.2.15; V.I.5; L.l.44; L.tr.3½-1-13.

Height 3, head 3.2 in length. Eye 2.6 in head, somewhat longer than snout and somewhat more than interorbital space. Scales on head beginning between anterior part of eyes, by far not reaching line connecting nostrils. Maxillary reaching to behind nostrils, almost reaching frontborder of eye. Praeoperculum with 5 transverse rows of scales, the inferior limb naked. Posterior border scalloped and denticulate. Praeorbital with a strong spine, smaller ones below it, only one of which is conspicuous. Dorsal spines moderate, the first more than half the length of the second, third to sixth longest, equal to about snout and half eye. Other spines somewhat shorter. Soft dorsal rounded, as high as spinous part. First anal spine less than half length of second. Second spine by far the strongest, subequal to third. Soft anal as deep as dorsal, rounded. Pectorals somewhat longer than head without snout. Ventrals shorter than pectorals. Colour of alcohol specimen brownish. A large blackish brown spot on posterior part of operculum. A silvery band, three scales broad, along the trunk below lateral line. In the anterior part it is crossed by two narrow short oblique brown streaks, the middle part with a brown spot on the base of each scale, forming oblique rows.

One specimen from Sabang, 156 mm. According to the length of the maxillary this specimen could belong to *Scolopsis cancellatus* C. V., but the five rows of scales on the operculum and the colouration show its affinity to *Scolopsis xenochrous*.

Litterature:

1. *Scolopsis xenochrous* GÜNTHER, Ann. Mag. Nat. Hist. (4) V, 1872, p. 423.
2. *Scolopsis xenochrous* WEBER and DE BEAUFORT, Fishes of the Indo-Australian Archipelago VII, 1936, p. 338.

PENTAPUS C. V.

Pentapus microdon (BLKR.).

D.X.9; A.III.7; P.2.14; V.I.5; L.l.49; L.tr.2½-1-16.

Height 3.5, head 3.3 in length. Eye 3.3 in head, equal to snout, somewhat less than convex interorbital space. Mouth somewhat oblique, maxillary reaching

nearly to below frontborder of eye. Teeth in bands in both jaws, the outer series enlarged. In the upper jaw a few moderate canines, none in lower: Posterior border of praeoperculum serrated. Six curved rows of scales on praeoperculum, transverse behind eye, longitudinal below eye. Praeorbital pointed behind, not scaly. Middle dorsal rays longest, somewhat longer than postorbital part of head. Origin of anal below second soft dorsal ray. First anal spine about half as long as second, which is about three fourth of third. Third spine longer than snout. Pectorals about as long as head without snout, ventrals somewhat longer, its first soft ray prolonged. Ventral spine as long as dorsal ones. Least height of caudal peduncle equal to postorbital part of head. Caudal deeply forked, the lobes not prolonged. A silvery band from head to caudal peduncle (alcohol-specimen!).

One specimen from Singapore 115 mm. From an old collection from the fisheries-investigation steamer "Gier".

Litterature:

1. *Heterognathodon microdon* BLEEKER, Nat. Tijdschr. Ned. Indië IV, 1853, p. 464.
2. *Heterognathodon microdon* GÜNTHER, Cat. Brit. Mus. 1859, p. 366.
3. *Heterognathodon canunis* GÜNTHER Fische der Südsee I, 1873 - 1875, p. 32 (nec. C. V.).
4. *Pentapus microdon* BLEEKER, Verh. Akad. Amsterdam XIII (1872), 1873. Révision Dentex, p. 36. — Atl. Ichth. VIII, 1876 - 1877, p. 101.
5. *Pentapus microdon* WEBER and DE BEAUFORT, Fishes of the Indo-Australian Archipelago VII, 1936, p. 389.

CAESIO LACÉPÈDE.

Caesio tile C. V.

D.XI.21; A.III.12; P.2.22; V.I.5; L.l.72; L.tr.6½-1-16.

Fusiform. Dorsal and anal profile evenly convex from snout to caudal. Height about 3.5, 4.3 in length with caudal. Head 3.7 in length. Eye 4 in head equal to snout, about 1.7 in convex interorbital space. Maxillary reaching to below frontborder of pupil. Teeth in upper jaw in two rows, anterior consisting of conical, moderate teeth. The inner row minute. Teeth in lower jaw moderate as in upper, only near symphysis in two rows. No teeth on palatines vomer and tongue. Supratemporal band of scales confluent with the band on the other side, 3 scales deep laterally, 5 scales when it is confluent, 10 or 11 scales long. Origin slightly behind that of ventrals. First dorsal spine minute, third longest, about equal to postorbital part of head. Dorsal gradually decreasing in height posteriorly. Last soft ray about equal to eye. Origin of anal opposite to fourth dorsal ray. First anal spine small. Second and third subequal, much longer than snout. Pectorals pointed, somewhat shorter than head. Origin of ventrals somewhat behind the middle of the distance between tip of snout and origin of anal. Their length longer than eye and snout. Caudal deeply forked, lobes pointed. Colour of fresh specimen dark bluish above, reddish below. The two areas

separated by a rather broad light bluish band with a metallic hue. This metallic hue is found also on the back, but here in a lesser degree. Dark medium stripes on the lobes of the caudal fin which is bordered by red. The lower border of the bluish area on the sides is continued in the lower border of the medium stripe of upper lobe of caudal fin. All other fins reddish. Axil of pectorals black. A blotch at upper part of base of pectorals.

Many specimens in the catch of Japanese fishermen at the fishmarket of Batavia. Caught near the coast of South-West Celebes. Exact locality unknown.

Litterature:

1. *Caesio tile* CUVIER & VALENCIENNES. Hist. Nat. Poissons VI, 1830, p. 428.
2. *Caesio tile* GÜNTHER, Fische der Südsee I, 1873 - 1875, p. 34.
3. *Pterocaesio multiradiatus* BLEEKER, Atl. Ichth. VIII, 1876, p. 41.
4. *Pterocaesio multiradiatus* FOWLER & BEAN, Proc. U.S. Nat. Mus. LXII, 1922, p. 38.
5. *Caesio tile* CHABANAUD, Bull. Soc. Zool. France L, 1925, 151.
6. *Caesio tile* FOWLER, Mem. B. P. Bishop Mus. X, 1928, p. 204.
7. *Caesio tile* WEBER and DE BEAUFORT, Fishes of the Indo Australian Archipelago VII, 1936, p. 296.

APRION C. V.

Aprion virescens C. V.

D.XII.10; A.III.8; P.II.15; V.I.5; L.l.50; L.tr.6½-1-18.

Height 4, head 3.2 in length without caudal. Eye 5 in head more than twice in snout and twice in flat interorbital space. Mouth oblique. Maxillary not quite reaching frontborder of eye. Teeth in villiform bands with an outer row of canines in front of jaws. Scales on head beginning behind eyes with an elongated band of 4 rows of scales widely separated from that of the other side and narrowly from the scales on body. Seven to eight rows of scales on praeoperculum smooth. Dorsal spines flexible. First dorsal spine small, others subequal gradually diminuishing in height backwards. Soft part of dorsal as high as last spines, its last ray prolonged. Height of dorsal shorter than length of snout. Anal spines flexible, the first one minute, the third as long as soft rays, which are about as high as soft dorsal rays, last ray prolonged. Pectorals rounded, as long as snout. Ventrals somewhat longer. Ventral spine about equal to postorbital part of head. Caudal deeply forked, the lobes pointed. Least height of caudal peduncle about twice in its length. Colour, when fresh, bluish, lighter below. Each scale with a dark streak. A series of violet blotches at base of the membrane of the five last dorsal spines. Pectorals yellowish. Ventrals with darker bluish tips.

One specimen. Total length 63 mm. Caught in the Java Sea near Billiton. August 1937. According to WEBER and DE BEAUFORT the formula for the dorsal fin is X.11. My specimen has XII.10, just as given by BLEEKER in his Atlas Ichthyologique.

Litterature:
2. *Aprion virescens* CUVIER & VALENCIENNES, Hist. Nat. Poissons VI, 1830, p. 544.
2. *Mesoprion microchir* BLEEKER, Nat. Tijdschr. Ned. Indië V, 1853, p. 332.
3. *Lutjanus microchir* BLEEKER, Ned. Tijdschr. Dierk. I, 1863, p. 233.
4. *Chaetopterus microchir* BLEEKER, Verh. Akad. Amsterdam (2) III, 1869 p. 85.
5. *Aprion virescens* GÜNTHER, Fische der Südsee I, 1873, p. 16.
6. *Aprion (Aprion), virescens* BLEEKER, Verh. Akad. Amsterdam XIII (1872) 1873, Révision Lutjanus, p. 92. Atl. Ichth. VIII, 1876 - 1877, p. 77.
7. *Aprion virescens* JENKINS, Bull. U.S. Fish Comm. XXII (1902), 1904, p. 452.
8. *Aprion virescens* SNYDER, ibid. p. 527.
9. *Aprion virescens* JORDAN & EVERMANN, ibid. XXIII (1903), 1905, p. 239.
10. *Aprion virescens* M. WEBER, Siboga Exp. Fische, 1913 p. 257.
11. *Aprion virescens* FOWLER, Mem. B. P. Bishop Mus. X, 1928, p. 193.
12. *Aprion virescens* MC. CULLOCH, Checklist Fish. Austr. Mem. Mus. V, Prt. II, 1929, p. 202.
13. *Aprion virescens* WEBER and DE BEAUFORT, Fishes of the Indo-Australian Archipelago VII, 1936, p. 311.

SYMPHORUS GÜNTHER.

Symphorus gibbifrons nov. spec.

D.X.7; A.III.10; P.I.16; V.I.5; L.l.54; L.tr.10-1-23.

Height 2.1 head 2.8 in length. Eye 4.7 in head, about once in snout. Profile of head almost rectangular with a rounded protuding elevation just before eyes. Maxillary reaching to below second half of head. Teeth small, short, conical and molarlike. One row of them in upper jaw and about 3 irregular rows of smaller ones in lower. In front of each jaw a row of blunt canines. Pectorals about as long head, longer than longest anal ray. Ventrals about as long as head without snout. Dorsal short, about as long as eyes. Soft anal pointed. First soft ray the longest, no filament. Caudal slightly incised. About 15 longitudinal somewhat vermicular stripes on body. Continued on head below eye. Above the eye all the lines are vermicular. A black spot on dorsal side of caudal peduncle.

One specimen. Total length 49 cm. Thousand Islands. March 1937. Soft dorsal damaged.

Fam. **MOLIDAE.**

MOLA LINCK.

Mola lanceolata (LIÉNARD).

Compressed. Hind end of body triangularly produced into a taillike organ. Height of body twice in total length. Head about 4 in total length. Eye somewhat smaller than branchial opening, somewhat more than twice in pectoral fin.

Anal and dorsal fin about 2.5 in total length. Profile of snout rounded. Mouth small, terminal. Height of "tail" somewhat more than height of vertical fins, which are more or less falcate. Skin granular. Chin not prominent.

One specimen 68 cm. Bay of Batavia August 1937.

Fam. **ELEOTRIDAE.**

VIREOSA JORDAN and SNYDER.

Vireosa hanae JORDAN and SNYDER.

D.VI.I.25; A.I.25; P.23; V.I.4.

Head 5.5 in length, height 7.5. Depth of caudal peduncle 9.5 in length of head and body. Eye 3.5 in head, 1.5 in postorbital part. One or more short barbels on chin. Lower jaw longer than upper. Cleft of mouth large, almost vertical. Maxillary reaching to below frontborder of eye. Teeth in upper jaw in two series. The anterior consists of rather long fanglike curved canines. The inner teeth are minute. In the lower jaw a series of similar canines, with minute minute teeth between it and a single row of conical teeth outwards of the canines. Scales minute, slightly embedded in the skin. First dorsal just connected with second. First five rays of spinous dorsal separated from sixth which reaches the soft dorsal when depressed. Upper and lower rays much prolonged. Pectorals and ventrals rounded. Colouration completely faded in alcohol.

About twenty specimens were received in a living condition in the Aquarium at Batavia, 30-9-'36. They were kept alive and only two were put in alcohol. As at that time I did not know that we had to do with a species hitherto unknown from the Indo-Australian seas no notes were made of the colours. They were however mainly green with some brilliant red stripes and blotches. Dr. F. P. KOUMANS from the Leyden Museum was so kind as to give me the name of this species. Longest specimen about 100 without the caudal filaments.

1. *Vireosa hanae* JORDAN & SNYDER, Prod. U.S. Nat. Mus. XXIV, 1901, p. 38.

ADDITIONS TO THE „FAUNA BURUANA *(Coleoptera-Carabidae)*", by H. E. Andrewes.

By

S. L. STRANEO

(Parma, Italy).

Thanks to Messrs. H. E. ANDREWES and J. B. CORPORAAL, I have been able to study the few examples belonging to the genus *Caelostomus* MACL., of which Mr. ANDREWES treated in 1930 (Treubia Vol. VII, Suppl., p. 333).

I found that No. 13 was a new species, described below as *Caelostomus buruanus* n. sp. No. 14 is, as Mr. ANDREWES thought, an example of *Caelostomus similis* JORD. (Nov. Zool. I, 1894, p. 109; STRANEO, Ann. Mus. Genova LX, 1938, pp. 20, 62). No. 15 belongs certainly to the species from New Guinea which I described (l.c. pp. 21, 76) under the name of *Caelostomus loriai*, but it is impossible to say, on a single example, whether it belongs to the typical form or to a local variety or subspecies. The four specimens referred to under No. 16 are examples of *Caelostomus minor* JORD. (l.c. p. 108; STRANEO, l.c. pp. 22, 89).

These determinations are quite correct, as I have seen all the types of the above cited species.

Caelostomus buruanus n. sp.

Long. 7 mm; max. lat. 3 mm.

Colore nigro distincte iridescente, antennis, palpis pedibusque rufo-ferrugineis.

Caput modice sculptum, oculis mediocriter amplis et convexis, temporibus nullis, sulcis frontalibus sat profundis, tantum usque ad primum porum supra-ocularem productis; antennis robustis et brevibus, articulis 4 - 11 pubescentibus, 5 - 11 moniliformibus.

Pronotum transversum, modice convexum; long. 1,7 mm; max. lat. 2,2 mm; lateribus antice sat rotundatis et constrictis (lat. ant. 1,5 mm), postice parum et recte convergentibus (lat. basis 2 mm); angulis anticis perparum prominentibus, posticis parum obtusis, apice dente parvo instructis; sulcis basalibus dimidiam longitudinem pronoti non attingentibus, modice curvatis et antice convergentibus; canaliculo laterali angusto, poris setigeris binis usitatis praedito; basi levi, non punctata, perparum obliqua latera versus; disco modice convexo, linea media angusta et mediocriter impressa.

Elytra subparallela; long. 4,1 mm; max. lat. 3 mm; humeris obtusis, valde rotundatis, apice non distincte dentato; margine basali integro; striis profundis, basim non attingentibus, mediocriter crenulatis; interstitiis valde convexis; tertia

stria poro conspicuo ad basim instructa; disco convexo, declivio apicali sat abrupto; apice breviter et obtuse rotundato.

Subtus proepisternis levibus, 2 - 3 punctis, in sutura interiore positis, praeditis; prosterno longitudinaliter sulcato, processu ad apicem impressione parva et profunda, quasi foveola, notato; metepisternis longis et sat fortiter punctatis; metasterni angulis 3 - 4 punctos ferentibus; sternitibus sulcatis secundum basim, lateribus fortiter et parum crebre punctatis; sternite anali maris puncto singulo utrinque instructo.

Pedes regulares, tarsis anticis maris modice dilatatis, tibiis anticis spinulis binis subtilibus, praeter apicalem, instructis; onychio subtus glabro.

Microsculptura regularis, levissima.

Habitat: Boeroe (Buru), Wai Eno to Wai Temoen, 700 - 1000 m (L. J. TOXOPEUS).

Holotypus ♂ et unicum specimen in Zool. Mus. Amsterdam.

The peculiar characters of this species, viz. antennae moniliform, metepisterna elongate, lateral margin of pronotum with two setigerous pores, basal grooves of the pronotum narrow and not longer than the basal half of the pronotum, anterior tibiae with only two lateral spines, anterior tarsi of the ♂ feebly dilated and sides of metasternum with some punctures, put this new species in my key of oriental *Caelostomus* (l.c. pp. 17 - 22), near *C. subiridescens* STRAN. (l.c. pp. 20, 68). *C. buruanus* is easily distinguishable by the sides of the pronotum more rectilinearly convergent towards base, the elytra more convex and more abruptly declivous near apex, with the striae not reaching the basal margin, and the proepisterna punctate only in the sutures.

The character of the elytral striae not reaching the base is present also in *C. mariae* STRAN. (l.c. pp. 20, 60): but the other characters are different and *C. mariae* is smaller.

ZWEI NEUE VÖGEL VON DER INSEL MOROTAI.

Von

A. C. V. VAN BEMMEL

(Zoölogisch Museum, Buitenzorg).

Im Frühjahr 1938 besuchte Herr G. DE HAAN von der Boschbouwproefstation Buitenzorg (Java) im Dienste der Waldexploration die Molukken-Inseln Ternate, Halmahera und Morotai. Neben seiner eigentlichen Explorationstätigkeiten fand Herr DE HAAN noch Zeit, eine kleine Vogel-Sammlung anzulegen, welche er dem Zoologischen Museum Buitenzorg schenkte. Als ich die Ausbeute von der Insel Morotai durchsah, fand ich dabei einen Brillenvogel, der sich als neu erwies. Eine Beschreibung lasse ich hier folgen:

Zosterops dehaani nov. spec.

Typus: ♂ Cat. No. 9847 Zoöl. Museum Buitenzorg 29-III-1938 Kpg. Pilowo. Morotai. Leg. G. DE HAAN.

Paratypen: ein ♂ und ein ♀ von demselben Fundort und Datum.

Diagnose: Oberkopf und Ohrgegend sehr dunkel-schwarzbraun. Zügel grauweiss. Oberseite graubräunlich. Oberschwanzdecken düster olivgrün. Handschwingen mit trüb gelbolivem Saum an der Aussenfahne, Innenfahne mit schmalem weissen Saum. Steuerfedern dunkelbraun, mit dunkeloliven Rändern. Ganze Unterseite schmutzig weiss. Körperseiten grau verwaschen; Unterflügeldecken weiss. Unterschwanzdecken schmutzig weiss bis gelbgrau. Um das Auge einen deutlichen Ring von blendend weissen Federchen. Schnabel dunkelgrau, Unterschnabel an der Wurzelhälfte abgesetzt hellgrau. Füsse hellgrau. Augen lebhaft braun. *Habitat:* Morotai. *Oekologie:* Tieflandform.

Flügel: ♀ 59,5 mm ♂♂: 59,5; 61 mm.

Culmen: ♀ 12,3 mm ♂♂: 12; 12,3 mm.

Als Namen der Eingeborenen für diesen vogel gibt Herr DE HAAN „Kaibi" oder „Kalaebi" an.

Es ist sehr schwer, die Verwandtschaft der neuen Form festzustellen.

Die Systematik der Zosteropidae westlich der WALLACE'schen Linie erscheint jetzt nach der letzten Arbeit STRESEMANN's (Journ. f. Ornith. 87. 1939 p. 156) ziemlich geklärt und vereinfacht. Leider ist dies mit den östlichen Formen bis jetzt noch nicht der Fall, wenn auch STRESEMANN in seiner früheren Arbeit (Mitt. Zool. Mus. Berl. 17. 1931. p. 201) Ordnung in dem vorher herrschenden Chaos geschaffen hat.

Dass die neue Form in den von STRESEMANN aufgestellten Artenkreis *Zosterops atriceps-anomala-delicatula* (XVI) gestellt wird, scheint mir angebracht. *Zosterops dehaani* liegt mitten im Verbreitungsgebiet dieses Artenkreises, zeigt eine lipochromfreie Unterseite, geschwärzten Oberkopf und braune Iris.

Die neue Form kommt dem Rassenkreis *atriceps* am nächsten. Gemeinschaftlich damit hat sie u.a. die Färbung der Füsse, die gleiche Zeichnung der Handschwingen und die eigentümliche Schnabelfärbung mit abgesetzt heller Wurzelhälfte des Unterschnabels. [1]) Ueberdies ist *dehaani* die unmittelbare geographische Fortsetzung des *atriceps*-Rassenkreises, und wie diese eine Tieflandform. Sie unterscheidet sich von letzterer aber durch die graubraune, nicht olivgrüne Oberseite, fast völlig lipochromfreie Unterschwanzdecken, weit deutlicheren Augenring und schliesslich durch den grauweissen Zügel. Brauchen auch die ersten Merkmale nach STRESEMANN nicht notwendig Artcharactere zu sein, mit dem letzten Merkmal steht, soweit ich nachgehen konnte, *Zosterops dehaani* in dem ganzen Artenkreis allein. Ich glaube deshalb, die neue Form vorläufig besser als eigene Art anführen zu können.

In derselben Sammlung des Herrn DE HAAN befindet sich weiter noch eine Form von *Pitta maxima* welche erheblich von der Nominatrasse abweicht und deshalb subspezifisch abgetrennt werden kann. Die Art war bisher nur von Halmahera [2]) bekannt geworden.

Pitta maxima morotaiensis nov. subspec.

Typus: ♂ Cat. No. 12036 Zoöl. Museum Buitenzorg. 25-III-1938 Minoe-Minoe Ajer, ca 500 m. Insel Morotai. Leg. G. DE HAAN.

Paratypen: 2 ♂♂, 1 ♀ von Minoe-Minoe Ajer (ca 500 m), Gahoroe Malokoe (ca 800 m) und Tilei (ca 500 m) auf der Insel Morotai.

Diagnose: Unterscheidet sich von *Pitta maxima maxima* MÜLL. & SCHLEG. von Halmahera durch grössere Masse. Die Flügeldecken sind viel intensiver blau (etwa „ultramarine blue", RIDGWAY) als bei der Nominatrasse, wo sie etwa „cendre blue" sind. Die ersten Armschwingen sind dunkel grünblau gesäumt, bei den weiteren in ein dunkeles grün übergehend, bedeutend dunkler als bei *maxima*. Iris: braunschwarz, Schnabel: schwarz, Füsse: hell rosa grau. *Habitat:* Morotai.

Nachfolgend gebe ich eine Uebersicht der Masse beider Subspecies.

morotaiensis (Morotai):

3 ♂♂ Flügel: 156; 155; 154 mm, Culmen: 27; 26; 25,5 mm.

1 ♀ Flügel: 156 mm, Culmen: 26,5 mm.

maxima (Halmahera):

2 ♂♂ Flügel: 149; 146 mm, Culmen: 23; 22 mm.

2 ♀♀ Flügel: 144; 143 mm, Culmen: 23; 22 mm.

2 sex inc. Flügel: 149; 145 mm, Culmen: 23; 23 mm.

Als Namen der Eingebborenen für diesen Vogel gibt Herr DE HAAN „Gahoko" oder „Fo-Fo" an. Ueber die Verwandtschaft von *Pitta maxima* berichtet MEISE (Journ. f. Ornith. 1929. p. 465) ausführlich.

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[1]) Es lag mir zum Vergleich ein Paratypus von SALVADORI's *Zosterops fuscifrons* (terra typica Halmahera) aus dem Leidener Museum vor, den mir Dr. G. C. A. JUNGE freundlichst zur Verfügung stellte.

[2]) Die Angabe VORDERMAN's (Natuurk. Tijdschr. Ned. Ind. 58, 2. p. 225, 1898), dass *Pitta maxima* auf Batjan vorkommt, ist wahrscheinlich nicht richtig (Siehe: HARTERT, Nov. Zool. X 1903. p. 57 Fussnote).

FAUNA BURUANA.

COLEOPTERA: Fam. *Lampyridae, Cantharidae, Malachiidae, Prionoceridae*

(7. Beitrag zur Kenntnis der indo-malayischen Malacodermata).

Von

W. WITTMER

(Zürich).

Die hier aufgeführten Arten entstammen einer Bestimmungssendung, die ich von Herrn J. B. CORPORAAL (Zoölogisch Museum, Amsterdam) zugestellt erhielt. Die Tiere sind durchwegs von Herrn Dr. L. J. TOXOPEUS in den Jahren 1921 und 1922 auf der Insel Boeroe (Buru) aufgesammelt worden.

Fam. LAMPYRIDAE.

1. Atyphella testaceolineata PIC. Von Herrn M. PIC [1]) aufgrund eines Exemplares mit Fundort „Station 7", Sept. 1921, beschrieben. Die Type befindet sich in der Sammlung des Zool. Mus. Amsterdam.

2. Pteroptyx testaceum MOTSCH. Neu für die Insel Boeroe, bisher war die Art nur von Borneo gemeldet.

3. Tylocerocorneus antennatus GUÉR. Stationen 1 und 21, durch das ganze Jahr aufzufinden. Bisher nur von der Insel Boeroe gemeldet.

Fam. CANTHARIDAE.

4. Themus bicallosicollis PIC. Von Herrn PIC nach Stücken aus der Sammlung des Zool. Mus. Amsterdam beschrieben, wo sich auch die Type und Cotypen befinden. Die Eingliederung dieser Art in die Gattung *Themus* MOTSCH. kann meines Erachtens nur auf provisorischer Basis erfolgen. Beim ♂ ist die äussere Klaue an allen Tarsen gespalten, die Augen grösser, stark hervortretend, das letzte Abdominalsegment tief gespalten, alles Merkmale die auf die Gattung *Tylocerus* DALM. hinweisen.

Fundorte: Stationen 4, 9 und 17.

5. Tylocerus brevebasalis PIC. Diese Art liegt in besonders reicher Individuenzahl vor. Die Flügeldecken der ♀ sind dunkler gefärbt als die der ♂,

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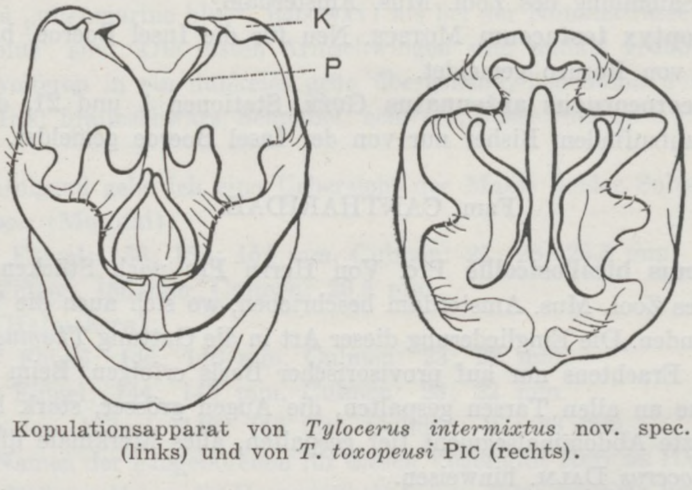
[1]) An dieser Stelle danke ich Herrn M. PIC bestens für seine Freundlichkeit einige der neuen Arten beschrieben zu haben, die ich ihm zum Vergleiche zusandte und die sich als neu herausstellten. Die Beschreibungen erschienen in den „Hors-Texte" der Zeitschrift l'Echange 1939, Seite 167 und folgende.

indem die dunkle Basalmakel, die sich bei den ♂ jederseits zwischen dem Schildchen und den Schulterbeulen befindet, beim ♀ breiter und verlängert ist, sie erreicht fast die Spitzen der Flügeldecken, die Naht und die Seiten bleiben hell (ab. *nigrovittatus* Pic).

6. Tylocerus toxopeusi Pic. Herr Pic beschrieb die Art nach Stücken aus der Sammlung des Zool. Mus. Amsterdam, woselbst die Type und zahlreiche Cotypen liegen, Cotypen befinden sich auch in der Sammlung Pic und bei mir. In der Färbung variert die Art ziemlich stark, Tiere mit einfarbig gelben Flügeldecken bilden die ab. *testaceipennis* Pic, die Stammform hat dunkle Flügeldecken mit schmalem, hellem Seitensaum, hellerer Spitze, oft ist auch die Naht gelb.

Fundorte: Stationen 3, 4, 5, 6, 7, 8, 9, 17, 18, 21 und 22, Januar bis Oktober.

7. Tylocerus intermixtus nov. spec. Vermischt mit *T. toxopeusi* Pic fanden sich Vertreter einer weiteren neuen Art vor, die mit dieser in Bezug auf ihren Habitus sehr nahe verwandt ist. In der Färbung unterscheiden sich die ♂ ziemlich konstant von *toxopeusi* Pic, währenddem bei letzterer Art die ♂ ausgesprochen dunkel gefärbt sind (ausgenommen ab. *testaceipennis* Pic) und die Naht der Flügeldecken höchstens sehr schmal gelb gefärbt ist, ist die Naht der Flügeldecken bei *intermixtus* n. sp. breit gelb gefärbt, kurz nach der Basis ist der gelbe Längsstreifen sogar breiter als der dunkle Streifen. Die deutlichsten Unterscheidungsmerkmale und sehr konstant, zeigt der männliche Kopulationsapparat. (Siehe Figur).



Kopulationsapparat von *Tylocerus intermixtus* nov. spec. (links) und von *T. toxopeusi* Pic (rechts).

Färbung: Gelbbraun bis orangebraun, dunkel sind die Augen, ein Flecken auf der Stirne zwischen den Augen (der oft in der Mitte unterbrochen ist), die Fühler bis auf das 1. und 2. Glied, die hauptsächlich auf der Unterseite mehr oder weniger hell sind, zwei kleine Flecken, manchmal ganz verschwommen, auf der vorderen Hälfte des Halsschildes kurz nach der Mitte, ein brauner bis dunkelbrauner Längsstreifen auf der Mitte der Decken, der sich an der

Basis bis gegen das Schildchen verbreitert, der dunkle Streifen ist fast von derselben Breite wie der helle Streifen jederseits an der Naht, nur gegen die Spitze wird er oft breiter, meistens jedoch ohne die Naht zu erreichen, Spitzen der Schenkel und meist auch die Tarsen dunkel. Die Abbildung des Penis (fig. 1) lässt den komplizierten Bau dieses Organes nicht ganz deutlich erkennen. Nach der Skizze könnte angenommen werden die Parameren (P) seien mit der Kapsel (K) verwachsen, dem ist jedoch nicht so, jede Paramere ist aus einem dünnen, gleichmässig dicken, wachsblattartigen Blatte gebildet, S-förmig gebogen, die Spitze verdreht, sie berührt kaum das Ende der Kapsel, die Basalspitze der Parameren ist umgebogen.

Fundorte: Stationen 1, 3, 4 und 6, Januar bis September 1921.

Type und Cotypen in der Sammlung des Zool. Mus. Amsterdam, Cotypen in meiner Sammlung.

Fam. MALACHIIDAE.

8. Carphurus rubroannulatus Motsch. Eine in der Färbung sehr variable Art. Die ♀ haben meist schwarze Flügeldecken, manchmal mit einem schwachen, blauen Metallschimmer, die Flügeldecken der ♂ sind meist schmutziggelb mit einer dunkeln Längsbinde an der Naht, oder die Längsbinde verbreitert sich an der Basis und an den Spitzen und bildet eine undeutliche X.

Verbreitungsgebiet: Indien, Ceylon, Tenasserim, Cochinchina, Siam, Penang, Singapore, Java, Sumatra, Borneo, Tonkin, Philippinen, Molukken.

9. Carphurus ruficeps Pic. Molukken (Amboina, Ceram, Batjan, Timor, Morotai, Soela).

10. Carphurus plicaticollis Pic. Molukken, Neu Guinea.

11. Carphurus dentaticornis Champ. Molukken, Neu Guinea.

12. Carphurus luzonicus Champ. var. Das mir vorliegende ♂ Exemplar stimmt ziemlich genau überein mit der Originalbeschreibung, die nach einem Stück vom Mt. Makiling, Luzon (Philippinen) verfasst ist, die Färbung ist jedoch verschieden, einfarbig gelb, bis auf die stark hervortretenden Augen, die Fühler vom 4. Gliede an und ein schmaler Längsstreifen auf den Tergiten, Teile die schwarz sind.

Fundort: Station 18, November 1921.

13. Carphurus bivittatus Champ. Das Vorkommen dieser Art scheint auf die Insel Boeroe beschränkt zu sein. Fundort: Station 1, März 1921.

14. Carphurus amboynensis Champ.? Wurde von Champion nach einem ♂ von Amboina beschrieben. Die Beschreibung würde, besonders was die Färbung und die Form des Halsschildes anbelangt, gut auf das einzige vorliegende ♀ passen, der Halsschild ist jedoch glatt, während der Autor für seine Art „prothorax sparsely punctured" angibt, Merkmal das auf das Exemplar von der Insel Boeroe nicht passen würde, da der Halsschild glatt ist.

15. Carphurus atricolor Champ. Neu für die Insel Boeroe. Bisherige Verbreitung: Timor, Alor, Leti, Ceram.

Vorgefunden auf Stationen 1 und 21.

16. Carphuroides pectinatus SHARP. Neu für die Insel Boeroe. Die Art ist über die Molukken und weit darüber hinaus verbreitert.

17. Laius cyaneus GUÉR. Von Neu Guinea beschrieben, bisher von der Insel Timor noch nicht gemeldet.

Fam. PRIONOCERIDAE.

18. Prionocerus bicolor REDT. Häufige Art, über die ganze indomalayische Region verbreitet.

19. Prionocerus caeruleipennis PERTY. Noch häufiger als die vorgehende Art bei gleicher Verbreitung.

NEUE BRENTHIDEN UND LYCIDEN AUS DEN HOLLÄNDISCHEN KOLONIEN.

Von

R. KLEINE

(Stettin).

Fam. BRENTHIDAE.

Araiorrhynchus lieftincki n. sp.

Einfarbig pechbraun, hochglänzend, Schenkel rotbraun, keine Filzbildung. Kopf quer, am Hinterrand in der Mitte tief dreieckig eingekerbt, auch die seitlichen Einkerbungen sind tief; Oberseite ungefurcht, zerstreut, nadelstichig punktiert. Metarostrum gewölbt, ungefurcht und wie der Kopf punktiert, vor dem Mesorostrum tief grubig eingedrückt; Mesorostrum seitlich erweitert, in Fortsetzung der Vertiefung des Metarostrums tief, schmal gefurcht, auf den seitlichen Rändern punktiert; Prorostrum wenigstens doppelt so lang wie das Metarostrum, kantig, an der Basis noch deutlich gefurcht, etwa von der Mitte ab flach. 2.-8. Fühlerglied quer, perlig, 9. und 10. tonnenförmig, 11. konisch, kürzer als das 9. und 10. zusammen, grob, einzeln punktiert und kräftig, gelb beborstet, das 9.-11. Glied ohne dichte Unterbehaarung. Prothorax dicht gefurcht, die Furchen erreichen den Vorder- und Hinterrand nicht, Punktierung sehr zerstreut und zart. Auf den Elytren ist die 2. Rippe (1. neben der Sutura) auf der Mitte weit unterbrochen, an der Basis sind die 1., 3. und 5. Rippe vorstehend, aus der 5. Rippe entspringt die 6., die sich wieder in die 6. und 7. teilt, die 8. ist nur in der Spitzenhälfte vorhanden, die 9. und 10. entspringen an der Basis.

Länge (total): 5.5 mm. Breite (Proth.) 1 mm circa.

S. Sumatra: S.W. Lampongs, Mt. Tanggamoes, Giesting, 800 m, XII.1934 (M. A. Lieftinck u. L. J. Toxopeus).

Typus (♂), im Museum Buitenzorg.

Es sind zwei Arten bekannt, bei denen die 2. Rippe unterbrochen ist. Davon ist eine Art in Afrika beheimatet, die andere in Birma. Gegen die birmanische Art (*beesoni* Kln.) bestehen folgende Unterschiede: die pechbraune Farbe, das Fehlen jeder Spur von Filzbelag, der tief eingekerbte Kopf, der hintere Augenrand ist nicht knotig verdickt, das 9. und 10. Fühlerglied sind nicht quadratisch, sondern länglich, tonnenförmig, der Prothorax ist nicht durchgehend gefurcht.

Fam. LYCIDAE.

Cladophorus solutus n. sp.

Tiefschwarz, Elytren mit einer breiten, gelbroten Mittelbinde, Prothorax und Schildchen; der schwarze Basalteil ist etwas grösser als der apicale, schwach glänzend, Elytren matt. Kopf ohne besondere Merkmale. Fühler robust, 3. - 10. Glied tief gezahnt, das 3. dreieckig, die folgenden nach und nach schlanker werdend, Behaarung sehr kurz. Prothorax am Hinterrand etwas breiter als in der Mitte hoch (Abb. 2.), Areolen deutlich entwickelt, die Randpunktierung, namentlich in der Spitzenareole kräftig, fast unbehaart. Schildchen gross, verkehrt-herzförmig, am Hinterrand tief eingebuchtet. Elytrengitterung vorwiegend quer, seltener quadratisch, dicht, kurz behaart.

Länge: 13 mm. Breite (hum.): 3 mm.

Ost-Borneo: Mt. Tibang, 1400 m (E. MJÖBERG).

Typus (♀) im Reichsmuseum zu Stockholm.

Es sind vom gleichen Fundort aus der Ausbeute MJÖBERGS schon zwei Arten bekannt, die sich durch andere Ausfärbung und völlig andere Elytrengitterung unterscheiden.

Cautires semiustus n. sp.

Tief sammetschwarz, nur die Elytren im hinteren Drittel hellchromgelb, mässig stark glänzend, Elytren matt. Stirn gerade, Fühlerbeulen schmal aber kräftig, unscharf getrennt. Lamellen des 3. - 10. Fühlergliedes etwa 2½ mal so lang wie das Glied selbst, schmal, dicht behaart, 11. Glied so lang wie das 9. und 10. zusammen. Prothorax Abb. 5, am Hinterrand etwa so breit wie in der Mitte hoch, Seitenränder kräftig aufgebogen, Randpunktierung, namentlich am Vorderrand, sehr kräftig. Schildchen verkehrt-herzförmig, Hinterrand keilförmig eingeschnitten, einzeln behaart. Elytren mit stark entwickelten Rippen und gleicher Gitterung von vorherrschend fünfeckiger, seltener quadratischer Gestalt (Abb. 6.).

Länge: 11 mm. Breite (hum.): 2.5 mm circa.

Ost-Borneo: Mt. Tibang, 1400 m (E. MJÖBERG).

Typus (♂) in meiner Sammlung.

Es gibt noch eine ähnlich gefärbte Art vom gleichen Fundort: *melanogaster* KLN. Die Unterschiede gegen *semiustus* sind: *melanogaster* ist grösser, robuster und breiter, die helle Partie der Elytren ist nicht hellchromgelb, sondern dunkelorange, der Prothorax ist quer, die Fühlerlamellen sind viel breiter und robuster.

Trichalus lineolatus n. sp.

Unterseite des Körpers, Beine, Fühler und Schildchen schwarz, Schenkel an der Basis hell, kurz behaart, Prothorax lehmgelb mit dunkler Mitte, Ränder hell, Elytren in der vorderen Hälfte lehmgelb, nach hinten allmählich schwarz werdend, Unterseite glänzend, Oberseite matt. Stirn tief eingedrückt, Fühler-

beulen quer, stark entwickelt. Fühler schlank, 1. - 4. Glied Abb. 8, die folgenden an Länge, die Spitzenglieder auch an Breite abnehmend. Prothorax am Hinterrand etwa so breit wie in der Mitte hoch, Areole schlank, hinten offen, Seitenränder aufgebogen und hinter der Mitte scharf zahnartig erweitert. Schildchen verkehrt-herzförmig, behaart. Elytren mit scharfen und kräftig entwickelten Rippen und gleicher Gitterung von 4 - 5eckiger Gestalt.

Länge: 8 mm. Breite (hum.): 1 mm circa.

Mittel-Java: Mt. Lawoe, Sarangan, 1400 m, VI.1937.

Typus (♂) in meiner Sammlung.

Die Art fällt durch den schlanken Habitus und den zweifarbigen Prothorax sofort auf und ist mit keiner anderen zu verwechseln oder in Vergleich zu stellen. Es ist wahrscheinlich, dass die schwarzen Farbenpartien an Umfang variabel sind.

Trichalus typicus n. sp.

Tief violetschwarz, fast schwarz, Prothorax orangegelb, matt, nur die Unterseite mit schwachem Glanz. Stirn steil abfallend, Fühlerbeulen sehr kräftig entwickelt. Fühler kräftig, 1. - 4. Glied Abb. 11, die folgenden von gleicher Gestalt, bis zum 10. an Länge und Breite etwas abnehmend, 11. so lang wie das 10. Prothorax quer (Abb. 10), Areole hinten offen, alle Ränder erhöht. Schildchen verkehrt-herzförmig, behaart. Elytren mit kräftigen Rippen und gleicher Gitterung von vorherrschend 5eckiger Form. (Abb. 12).

Länge: 8 mm. Breite (hum.) 1.5 mm.

Süd-Celebes: Nangala, 900 m. Rantepao XI.1937 (F. C. DRESCHER).

Typus (♂) in meiner Sammlung.

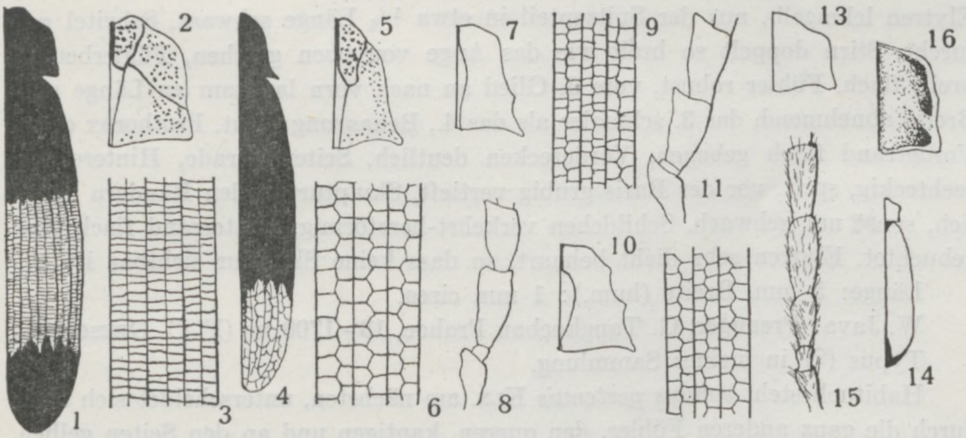


Fig. 1 - 3. *Cladophorus solutus*, n.sp.; 4 - 6. *Cautires semiustus*, n.sp.; 7 - 9. *Trichalus lineolatus*, n.sp.; 10 - 12. *Trichalus typicus*, n.sp.; 13. *Plateros nigrobrunneus*, n.sp.; 14 - 16. *Calochromus postmaculatus*, n.sp.

Ein Vergleich mit einer anderen Art ist nicht möglich, da es keine dieser Ausfärbung gibt. Es kann sich auch nur um einen typischen Vertreter von Celebes handeln, da diese Ausfärbung nicht weiter nach Norden oder Osten

vorkommt und die Molukken sich diesem Färbungstypus sonst wenig angepasst haben. Es ist also sofort zu sehen, dass es sich um ein Celebestier handeln muss.

Plateros nigrobrunneus n. sp.

Tief schwarzbraun, Fühler ganz schwarz, Hüften und Abdominalsegmente an den Seiten und Quernähten gelbbraun, Ränder des Prothorax und die Sutura bräunlich, Oberseite matt. Stirn 1½ mal so breit wie ein Augenhalbmesser, über den ganz flachen Fühlerbeulen gross, tief eingedrückt, einzeln kräftig punktiert und behaart; Augen gross, prominent. Fühler kräftig, 1. Glied klobig, gross, 2. klein, kegelig, 3. dreieckig, etwas länger als breit, die folgenden länger als das 3., 4. - 11. gleichlang, aber nach vorn zu an Breite allmählich abnehmend, alle Glieder dicht borstig behaart. Prothorax viel breiter als in der Mitte hoch (Abb. 13), alle Ränder schmal aber kräftig und deutlich aufgebogen, Mittelfurche kräftig, namentlich nach dem Hinterrand zu, Quereindruck kurz, Behaarung struppig, Punktierung einzeln. Auf den Elytren sind die Primär- und Sekundärrippen gleichstark, flach, Gitterung rundlich-quadratisch, überall dicht nadelstichig punktiert, abstehend behaart.

Länge: 9 mm. Breite (hum.): 2 mm.

N.O. Sumatra: Soekaranda (DOHRN).

Typus (♀) in meiner Sammlung.

Eine robuste, grosse Art. Durch die Gestalt der Fühler ist die Zugehörigkeit zu *Plateros* gesichert. Die Beschreibung kann ausnahmsweise ohne ♂ stattfinden.

Libnetis solidus n. sp.

Schwarzbraun, die Beine etwas heller, Prothorax mit gelben Rändern, Elytren lehmgelb, nur der Spitzenteil in etwa $^1/_6$ Länge schwarz. Scheitel gefurcht, Stirn doppelt so breit wie das Auge von oben gesehen, Fühlerbeulen breit, flach. Fühler robust, vom 3. Glied an nach vorn langsam an Länge und Breite abnehmend, das 3. schmaler als das 4., Behaarung dicht. Prothorax quer, Vorderrand flach gebogen, Vorderecken deutlich, Seiten gerade, Hinterecken rechteckig, spitz, vor der Basis grubig vertieft, Skulptur an den Rändern deutlich, sonst nur schwach. Schildchen verkehrt-herzförmig, Hinterrand flach eingebuchtet. Elytren sehr dicht behaart, so dass keine Skulptur sichtbar ist.

Länge: 5 mm. Breite (hum.): 1 mm circa.

W. Java: Preanger, G. Tangkoeban Prahoe, 13 - 1700 m (F. C. DRESCHER).

Typus (♀) in meiner Sammlung.

Habituell steht *solidus pertenuis* KLN. am nächsten, unterscheidet sich aber durch die ganz anderen Fühler, den queren, kantigen und an den Seiten gelben Prothorax und die dichte Behaarung der Elytren leicht und sicher.

Calochromus postmaculatus n. sp.

Brust und Abdomen blauschwarz, Beine, Kopf, Fühler und Schildchen schwarz, Prothorax und Elytren ziegelrot, letztere am Hinterrand in geringem Umfang angedunkelt (Abb. 14.). Stirn sehr flach eingedrückt, Fühlerbeulen nur

schwach entwickelt, Mandibulartaster ohne besondere Merkmale, das Spitzenglied beilförmig. 1. - 5. Fühlerglied Abb. 15, die folgenden Glieder nicht an Länge, sondern nur etwas an Breite abnehmend, 11. Glied kaum länger als das 10. Prothorax Abb. 16. Schildchen zungenförmig, Hinterrand gerade. Elytren dicht behaart, die Skulptur verdeckend. Beine ungedornt.

Länge: 8 - 9 mm. Breite (hum.): 1 - 1.5 mm.

W. Java: Preanger, G. Tangkoeban Prahoe, 13 - 1700 m (F. C. Drescher). 1 ♂♀. Typus in meiner Sammlung.

Durch Fühlerbildung und Ausfärbung von allen bekannten Arten verschieden.

schwach entwickelt, Mandibulartaster ohne besondere Merkmale, das Spitzenglied beilförmig. 1.–3. Fühlerglied Abb. 15, die folgenden Glieder nicht an Länge, sondern nur etwas an Breite abnehmend, 11. Glied kaum länger als das 10. Prothorax Abb. 16. Schildchen zungenförmig, Hinterrand gerade, Elytren dicht behaart, die Skulptur verdeckend. Beine ungedornt.

Länge: 8–9 mm, Breite (hum.): 1–1,5 mm.

W. Java: Preanger, G. Tangkoeban Prahoe, 13–1700 m (F. C. Drescher).

1 ♂♀ Typus in meiner Sammlung.

Durch Fühlerbildung und Ausfärbung von allen bekannten Arten verschieden.

PRELIMINARY DIAGNOSES OF NEW BIRDS FROM NORTH SUMATRA

by

F. N. CHASEN

(Director, Raffles Museum, Singapore).

Through the kindness of the Director of the Zoological Museum, Buitenzorg, I have been given the privilege of examining the large collection of birds made by Mr. A. HOOGERWERF at various places in the environs of Mt. Leuser and on the mountains itself in the Government of Atjeh, North Sumatra, in 1937. The collection contains some striking novelties. Some of these are described below as a preliminary to the publication of a more detailed report which is being prepared by Mr. HOOGERWERF and myself.

Turdus javanicus hoogerwerfi subsp. nov.

A very distinct form that needs no close comparison with any other race. In fresh plumage adult males are almost uniformly dull brownish black, but there is a small white patch on the lower abdomen and a few feathers on the centre of the abdomen are fringed with dull chestnut. In females the chestnut markings are more extensive. Bill and feet, orange. Worn parts of the plumage are paler, and the pale brownish grey crown and nape sometimes form a striking contrast with the darker mantle. Nearest to *T. j. indrapurae* from Mt. Korinchi in South-West Sumatra, but at once distinguished by the absence of the extensive chestnut area on the abdomen and flanks.

Type. — Adult male, collected on Mt. Leuser, Atjeh, North Sumatra, 3.000 metres (*c*), on 5th February, 1937. Mus. Buitenzorg No. 10156.

Specimens examined. — Ten males, and nine females.

Serilophus lunatus moderatus subsp. nov.

Nearer to *S. l. rothschildi* from the mountains of the Malay States than to *intensus* from Mt. Korinchi, South-West Sumatra, but the crown and nape are tinged with fulvous and the top of the head is therefore darker and less pure grey than in *rothschildi.*

Type. — Adult male, collected at Palok near Mt. Leuser, Atjeh, North Sumatra, 1.000 metres (*c*), on 29th January, 1937. Mus. Buitenzorg, No. 10068.

Specimens examined. — Four males, and one female.

Serinus estherae ripleyi subsp. nov.

Like the typical race from the mountains of West Java, but with more yellow on the head and breast in both sexes.

Type. — Adult male, collected on Mt. Leuser, Atjeh, North Sumatra, 3.300 (*c*) metres, on 1st February, 1937. Mus. Buitenzorg, No. 10107.

Specimens examined. — Two males, and two females.

Remarks. — The finding of this species, hitherto only known from Java, is one of the more remarkable of Mr. HOOGERWERF's ornithological discoveries on the mountains of North Sumatra. I have associated with this form the name of Mr. S. D. R. RIPLEY, one of Mr. HOOGERWERF's successors in the ornithological exploration of Mt. Leuser.

PRELIMINARY PLANKTON INVESTIGATIONS IN THE JAVA SEA.

By

Dr. H. C. DELSMAN

(Hilversum, Holland).

Introduction.

One of the first questions which the marine biologist is confronted with in the tropics is whether the tropical seas are as productive as the tropical soil when compared with what we find in higher latitudes. Already the wealth of shapes and colours, e.g. of the inhabitants of the coral reefs, and the great number of species found in the tropics awakens great expectations in this respect. In "Die Fische der Nord- und Ostsee" [1]) we find enumerated for the North and the Baltic Seas together about 250 true sea-fishes. For the seas of the Malayan Archipelago the number roughly estimated will be at least six times as large. On the other hand it can hardly be doubted that these fishes do not nearly occur in such enormous shoals as may be the case in the north. A visit to a sea-fish market on the Java coast is a disappointment to anyone who remembers the often enormous supply in the big European fishing ports. This may be partly ascribed to the more primitive methods of fishing with small vessels, without motor power, and with only primitive ways of conservation. But even experiments with modern methods, e.g. with steam trawling, did not yield very satisfactory results.

The dutch experiments by the exploration vessel "Gier" with trawling in the years 1907 - 1911 may be mentioned here [2]), and those with the steam trawler "Tongkol" from Singapore in 1926 - 1928. The latter, after a few years of exploration, was finally for some time worked on purely economical lines. It proved to be impossible to cover more than half of the expenses, even without any deductions [3]).

In this period the catches in 20 days amounted to:

29275 lbs = 12700 kg in water of 20 fathoms or more,

78506 lbs = 34000 kg in water of 10 fathoms (the former, however, fetching a prize of 18½ cents per lb against the latter 8 cents).

This corresponds with a daily catch of 635 and 1700 kg resp.

Now in the North Sea the daily catch of a steam trawler amounts to fully 1000 kg per day and the Singapore figures seem not to compare unfavourably with those for the North Sea which, it is true, are made for the greater part

[1]) 1929, in „Die Tierwelt der Nord- und Ostsee".
[2]) Mededeelingen van het Visscherijstation te Batavia.
[3]) Report on the Working of the S.T. "Tongkol" for the year 1927, Part II, p. 12.

in water deeper than 10 fathoms. However, we may not lose sight of the fact that the North Sea is an intensively fished area whereas the Java Sea and the South China Sea so far as regards bottom fishery, may be called absolutely virginal. Thus it would be more just to compare the Singapore catches with those made in the North Sea just after the end of the great war, when the trawl fishery had for some years practically lain idle and the fishing grounds had had opportunity to recover. In these years we find the following yields for the IJmuiden trawlers in the North Sea:

1919	2216 kg
1920	1854 kg
1921	1238 kg
1922	968 kg

so that in a virginal North Sea the daily catch may be easily taken to be more than 2000 kg; at any rate considerably higher than the Singapore catches.

The fact also that the sea fisheries in the Malayan Archipelago cannot satisfy the demand for fish, and that considerable quantities of dried and conserved fish must be imported every year from Siam and elsewhere (in 1932 e.g. to an amount of 11 million guilders) does not give us an impression of overwhelming wealth of the Malayan Seas. Very often, while cruising on the Java Sea, we have spoken to native fishing boats which had been rolling on the deep blue [1]) waves for days without catching anything with their payang net but a few small fishes.

A direct comparison, however, of the fish content and the yield of the fisheries e.g. of the Java Sea with that of the North Sea is very difficult, as not only the species are quite different but also the ways in which they are caught. Moreover, statistics are available for the Java Sea for the few last years only. An indirect indication could be furnished by a comparison of the quantities of plankton which are the final food source for everything living in the seas.

That the tropical seas are indeed poorer in general than those of higher latitudes has been suggested first by the results of HENSEN's plankton expedition which brought to light that the quantity of plankton in the tropical and subtropical ocean is considerably less than in the northern and, as has been shown by later expeditions, also in the Antarctic regions. The explanation of this phenomenon is given by the theories of BRANDT [2]) and of NATHANSOHN [1]). The former emphasized that it is the quantity of certain nutrient salts dissolved in the water on which the plankton production depends. The latter taught us that it is the vertical mixing of the sea water by which the deeper, fertile, layers are brought to the well-illuminated surface where photosynthesis can take place.

[1]) The desert colour of the sea, according to SCHÜTT. This does not mean to say that the Java Sea shows always and everywhere this deep blue colour, nor that the catches are always so scanty.

[2]) BRANDT, K., 1899, 1902, Über den Stoffwechsel im Meere. Wiss. Meeresunters., Kiel. N. F. Bd. 4 and 6.

[3]) NATHANSOHN, A., 1908, Über die allgemeinen Produktionsbedingungen im Meere. Intern. Revue d. ges. Hydrobiologie und Hydrographie, Bd. I.

Only where the surface water, depleted by plankton growth, is duly replaced by fertile water from the depth plankton growth is possible in the long run. In the tropics, however, as a consequence of the constant heating of the surface layers, no considerable vertical mixing takes place and the deeper layers, fertilized by decomposition and animal metabolism, are not brought to the surface unless under special circumstances. This accounts for the relative poverty of tropical seas as compared with those of higher latitudes where the succession of warm and cold seasons causes considerable vertical mixing. And where no rich plankton can develop, no rich macrofauna, no abundant fish population can either be expected.

Only under special conditions, as mentioned above, is a richer fauna found in tropical seas as well. This may be the case e.g. along coasts where constant off-land winds cause an upwelling of fertile water from the depth, or at places where a strong current passes over a sub-marine ridge. It would be worth while also with regard to fishery problems and possibilities, to find out what conditions are found in this respect in the different parts of the Indian Archipelago. How e.g. are things in the Java Sea? Is the plankton here rich or poor; is it better developed near the coast or at some distance away from it, and also what is the influence of the monsoons on the development of the plankton?

These questions induced me to make an attempt to obtain some insight into the nature of the plankton. The results are given below. After my return to Holland I had to leave it to my successors to continue these investigations and to elaborate upon my preliminary results.

During the years 1932 and '33, with the aid of Dr. J. D. F. HARDENBERG, I gathered a number of plankton samples from the Java Sea and from Sunda Strait. In studying these samples during the following years it was not so much my intention to make a complete inventory of the numerous species of copepods, diatoms etc. etc. occurring in the Java Sea plankton, (which, as emphasized already by Dr. SUNIER [2]), would require the coöperation of quite a number of specialists) as to get some insight into the local and seasonal distribution of its main constituents, which might prove to be of value also as a diagnostic in questions relating to fishery. In the course of the year 1932 I made two cruises across the Java Sea, from Java to Borneo and vise versa, as indicated on the maps illustrating this paper, visiting a number of stations which in general were taken closer to each other near the coast and further apart in the middle of the sea, where slighter differences might be expected. The first of these cruises was made in April, at the end of the, wet, west monsoon, the second in October, at the end of the, dry, east monsoon, so that the state of things at the end of these two seasons might be compared. Vertical hauls were made from near the bottom to the surface with an egg-net, width of the mouth 1⅓ m^2, length 4 m, Swiss planktongauze nr 3 (23 threads per 10 mm).

The Java Sea is shallow, the average depth in the centre, at least in the

[2]) A. L. J. SUNIER, 1921, Java Sea Plankton available for distribution to specialists. Treubia Vol. II.

western half, hardly exceeding 50 meters. Together with the South China Sea it forms part of the continental shelf on which Sumatra, Borneo and Java rest, and many big and smaller rivers of the three islands flow into this shallow sea. One might expect, therefore, to find that the plankton of the Java Sea would show certain peculiarities by which it differs from that of the surrounding, deeper, seas, e.g. of the Indian Ocean. To find out these differences and at the same time to study, if possible, the transition of the one plankton into the other, I made, in the year 1933, two similar cruises in Sunda Strait, beginning in the Java Sea and ending in the Indian Ocean. These voyages, too, were made one in April and the other in October. The results will be given in a later paper.

Besides my one-time assistant Dr. HARDENBERG, Ir. B. MARKUS, chemical engineer, also accompanied me on all these cruises. He made observations on the salinity and also on the phosphate-content of the sea-water at the different stations. The latter has proved in later years to be of great value for estimating the grade of fertility and the relative wealth also of nitrates and other nutrient salts of the water in different areas.

In examining the plankton samples attention was paid in the first place to the total amount of the sedimented plankton, and further to the relative quantity of phyto- and zooplankton, and finally to the numbers of a few prominent components of the plankton, which components were counted.

Salinity and phosphate content.

The shallow Java Sea has an almost rectangular shape; it is bordered on the north by Borneo and on the south by Java. SUNIER [1]) has calculated that it covers about the same area as the Red Sea, but the latter, being much deeper, has a contents of 10 × that of the Java Sea. The relatively shallow North Sea contains about double the quantity of water to that of the Java Sea.

SUNIER further gives the following short description of the bottom profile of the Java Sea, and of the temperature and salinity of its water as observed by captain K. M. VAN WEEL [2]) during the years 1917 - 1918:

"The bottom of the Java Sea shows everywhere a gradual slope from the coasts to the centre, the slope from the Java coast being slightly steeper than that from the Borneo shore. Besides, a very slight but gradual slope from W. to E. is also present, so that in general the western part of the Java Sea shows the lowest and the eastern part the highest depths. Thus the depth west of the meridian of Pekalongan, with the exception of a single channel, is everywhere less than 30 fathoms.

As regards the water of the Java Sea west of the meridian of 115° E, the extensive observations on the temperature and salinity gatheerd by the captain of our investigation vessel, K. M. VAN WEEL, show that, apart from

[1]) A. L. J. SUNIER, 1917, Voordracht over het Pelagiaal van de Javazee. 6e Bijeenkomst van Proefstationpersoneel, te Soerabaja op 29 Augustus 1917.
[2]) K. M. VAN WEEL, 1923, Meteorological and Hydrographical Observations made in the Western Part of the Netherlands East Indian Archipelago. Treubia Vol. IV.

the brackish water which may be present along the coast near the mouth of big rivers, the salinity during the whole year and over the whole area, in horizontal as well as in vertical sense, varies between fully 30.5 ‰ and fully 34.5 ‰.

The temperature in general varies only between slightly less than 27° C. The average temperature of the Java Sea water west of 115° E is during the monsoons hardly less than about 27.5° C; during both the change periods little less than about 29.0° C.

The salinity in the East monsoon and the subsequent change amounts to little more than 33.5 ‰; in the West monsoon and the subsequent transition period it is little more than 32.5 ‰.

BERLAGE [1]) has worked out more fully the data gathered by captain VAN WEEL in order to get an idea of the currents caused by the monsoons in the Java Sea. He concludes:

"Twice every year the Java Sea is completely swept clean. The yearly variation of salinity reaches 2 or 3 ‰. This variation would be much lower if the westerly and easterly stream were equally salt. The current coming from the shallow Southern China Sea, however, is less salt than that from the Flores Sea and Makassar Strait. To this asymmetry is due the fact that only one maximum and minimum salinity of the Java Sea exists. The former, as we have seen, is observed in the east monsoon about September, when the big westerly current comes to rest; the latter for the western part of the sea in the west-monsoon about February; for the eastern part at the monsoon change, in May".

Thus during the west-monsoon a west-east current prevails adducing water from the South China Sea; during the east-monsoon the current goes in inverse sense, adducing water from the Flores Sea. In the transition periods, when my observations were made, we find the end-stage of each of these movements. At the end of the east monsoon the highest salinities are found in the eastern part of the Java Sea, the highest temperatures in the western part. At the end of the west-monsoon the reverse state of things prevails, though less pronounced.

The salinity observations (by areometer [2])) made during our two plankton-cruises Java-Borneo and vice-versa in general agree with these conclusions, but at the same time show one peculiarity which is worth attention. A look at the curve diagram 1, which represents the surface salinities in April and October resp., reveals that in the middle of the Java Sea there is a place where in April, at the end of the west monsoon, the salinity is about the same as (in fact even slightly higher than) in October, viz. about 33.2 ‰. In the direction of the Java coast the two curves diverge, the surface salinity in April

[1]) H. P. BERLAGE, 1927, Monsoon-currents in the Java Sea and its Entrances. Verhand. Kon. Magn. en Meteor. Observatorium, Batavia.

[2]) as VAN WEEL (p. 320) and BERLAGE (p. 18) observe, VAN WEEL's areometer observations gave values about 0,5 - 1,0 % higher than those obtained by titration. It seems not improbable that we have used the same areometer.

being increasingly lower than in October the nearer we approach the coasts. But at the stations 11 - 13 of the western route and at the stations 30 - 31 of the eastern route we find no difference, the salinity being here about 33.2 ⁰/₀₀ and 33.5 ⁰/₀₀ resp. in April as well as in October. The same phenomenon is observed if we compare the salinities close above the sea bottom, although here the curves sink less and diverge less when approaching the coasts. At the same stations we find here too about the same values for the salinity in April and October, viz. about 33.8 ⁰/₀₀ for stations 11 - 12 and about 34 ⁰/₀₀ for station 30.

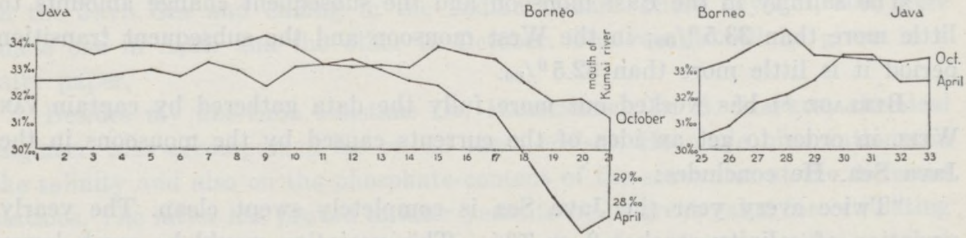


Diagram 1. Salinity at the surface in April and October 1932. The numbers at the horizontal axis in this and all other diagrams represent the different stations as given on the chart.

Evidently, then, the influence of the seasonal changes in the inflow of fresh water from the coasts of Java and Borneo seems not to reach to the middle of the Java Sea; at least this was the case in 1932. There remains a central band here where the salinity has remained constant, although being lower than in the surrounding oceans, viz. under 34 ⁰/₀₀. The direction of this band is indicated by a line uniting the stations 30 - 31 with 11 - 13, being west-northwest — east south-east. It runs over the central deepest channel of the Java Sea (as shown by the bathygraphicmap) where probably the great monsoon currents are also strongest, as many be derived from the course of the isobaths. Nearer the coasts we see the salinity decrease, especially at the surface and especially at the end of the west monsoon (April); and under the Borneo coast, with its many big rivers, still more so than under the Java Coast. From these coasts a belt of brackish water spreads over the more salt-laden water in the middle and in the depth of the Java Sea, gradually mixing up with the latter, so that the difference between surface and bottom salinity gradually decreases when approaching the central part of the Java Sea, without, however, quite disappearing even here. Only the seasonal variations in the coast water do not reach up to this central band, as we have seen above. We may not loose sight of the fact, however, that the water found in October, e.g. at the stations 11 - 13, cannot be the same as that found in April at the same place and that a great displacement has occurred as a consequence of the monsoon currents. Whether the salinity at these stations remains constant also during the monsoons cannot be derived from our data.

We see that the water of the Java Sea has a lower salinity at the surface than in the depth. At the same time the surface water is warmer than the water at the bottom. It needs not be emphasized that these circumstances are

not favourable for vertical convection movements which are of such importance for the plankton development. Only the waves and the monsoon currents may cause a certain mixing up of the higher and the lower water layers. During the two changes conditions must be specially unfavourable in this respect. On the other hand the Java Sea is not so deep that the sunlight could not penetrate even into the lowest layers, so that even these are not excluded from photosynthesis and plankton production as is the case with the deeper, dark, layers of the ocean.

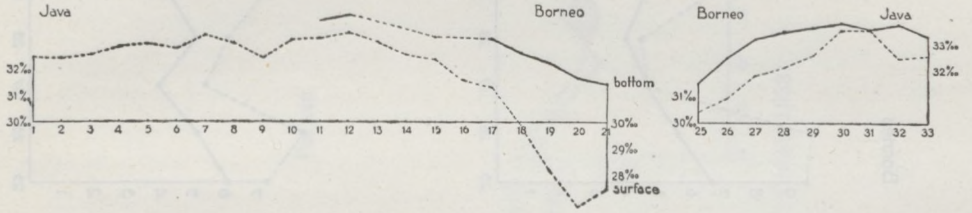


Diagram 2. Salinity in April 1932.

Together with our plankton observations Mr. B. MARKUS made determinations of the P_2O_5-content of the water in the Java Sea, using the colorimetric method of DENIGÈS, as modified by ATKINS [1]).

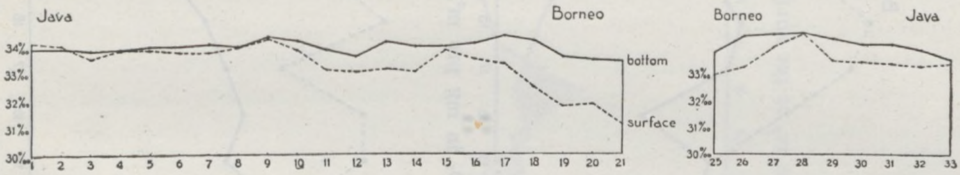


Diagram 3. Bottom- and surface salinity in October 1932.

In table I, I give his results which, moreover, have been combined in diagrams 1 - 6.

Great variations were not found. In general the values swing around an average of 5 - 6 mg/m³ P_2O_5 at the surface and about 7 - 8 in the depth. The lowest value was 2.5 mg/m³ whereas the 10 mg/m³ - limit was exceeded only in a very few cases, mostly near the coast or in the deeper water.

At each station two determinations of the P_2O_5-content were made, viz. one at 1 m below the surface and one quite near the bottom. It proved to be a general rule that the value found near the bottom was slightly higher than the one near the surface. Thus we find for average P_2O_5 content in

	surface	depth
April	5.6	8.0
October	5.6^5	8.1.

As the diagrams 4 and 5 show the difference, just as with the salinity, increases near the coast, although the vertical distance between the two obser-

[1]) W. R. G. ATKINS, 1923, The Phosphate Contents of Fresh and Salt Waters in Relationship to the growth of the Algal Plankton. Journ. Mar. Biol. Ass. Bd. 13.

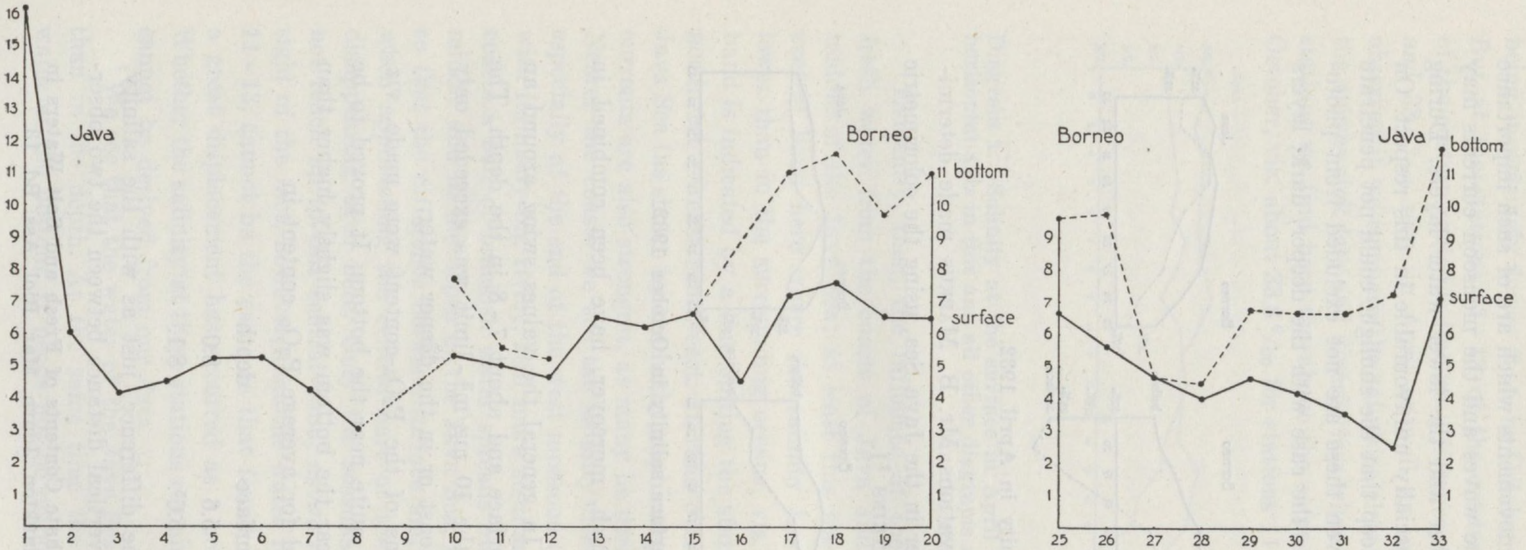


Diagram 4. P_2O_5 in mg pro m^3. April 1932.

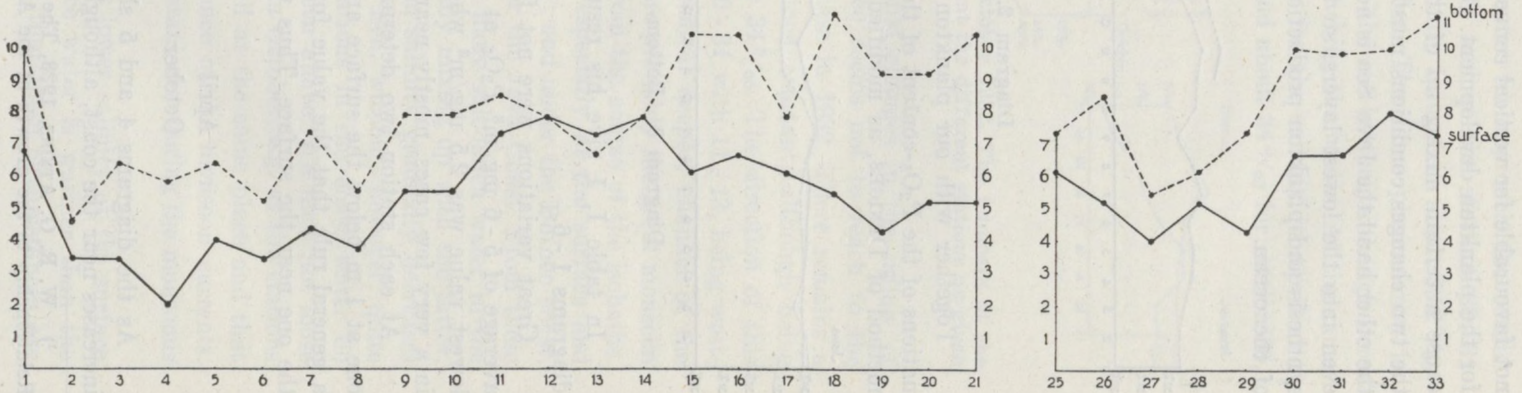


Diagram 5. P_2O_5 in mg pro m^3. October 1932.

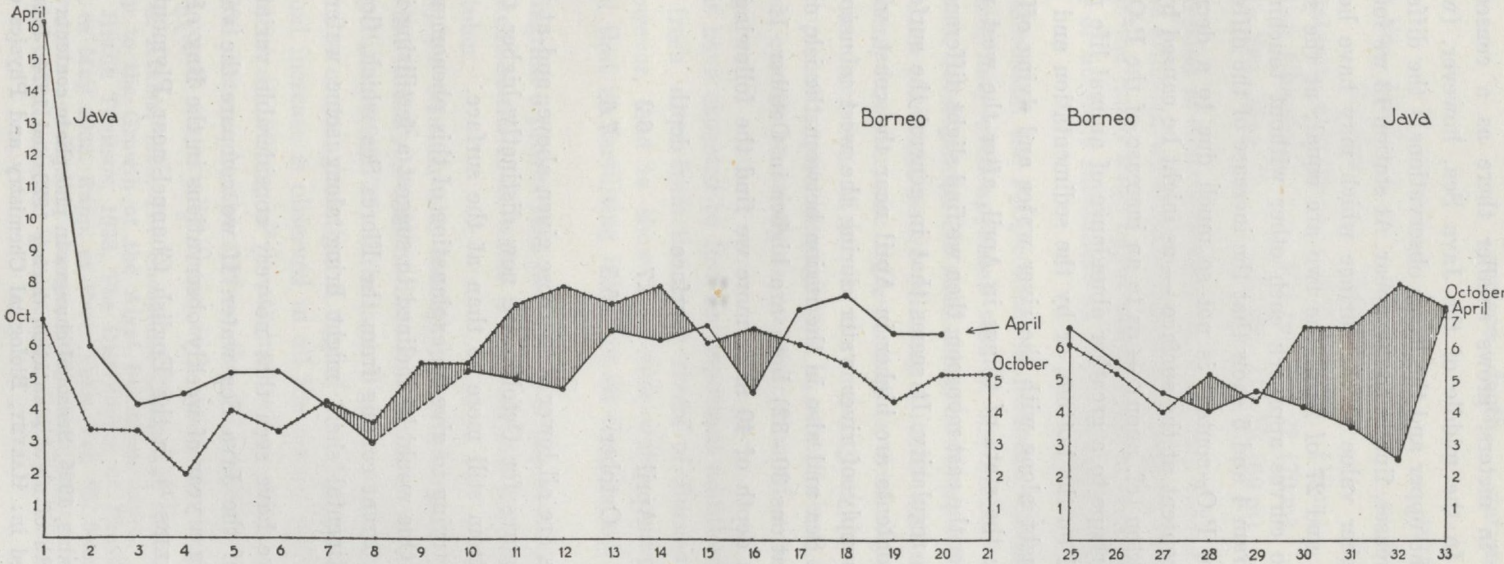


Diagram 6. P_2O_5 in mgr pro m^3 at the surface April and October 1932.

vations, expressed in meters, grows smaller there as a consequence of the decreasing depth. In the middle of the Java Sea, however, (with increasing distance between the upper and the lower observations!) the difference between the two values decreases, finally to disappear. At station 13 we found in October even a slightly higher value at the surface which may have been accidental. At the stations 15 and 27 of April the two are equal; at the stations 27 - 28 of October the two curves approach each other without touching each other.

A look at diagram 4 and 5 show that the increase of the difference between surface and bottom P_2O_5-content is not so much due to a decrease near the coast of the P_2O_5-content at the surface — as might be caused by the presence of more phytoplankton (cf. anon) — as to an increase of the P_2O_5-content near the bottom, due perhaps to a greather abundance of animal life near the coast, especially near and on the bottom, or by the sedimentation and decomposition of animal life brought along with the river water and dying off in the sea.

If we compare the state of things in April, after the west monsoon, with that in October, after the east monsoon, then we find slight differences only which yet show a certain regularity. It seems that in general the surface as well as the bottom P_2O_5-contents are higher in April near the coast, which might be attributed to the supply of river water during the west monsoon. But in the middle of the Java Sea and also in the region between the isle of Bawean and the Java coast (stations 30 - 32) both are higher in October. If we take only the stations with a depth of 40 m or more we find the following averages:

	surface	depth
April	4.7	6.2
October	5.5	7.6.

These averages are all lower than those given above, and at the same time we see that the figures for October are now distinctly higher than those for April, near the bottom still more so than at the surface.

I refrain from trying to give an explanation of this phenomenon until more date are available. One would be inclined to suggest a fertilizing influence from the east monsoon current coming from the Flores Sea which, flowing over the border of the continental shelf, might bring along some water from deeper regions.

At any rate we have seen that no very considerable variations occur in the P_2O_5-content of the Java Sea water. If we compare the values found in the Java Sea during a year of weekly observations in the Bay of Batavia with those found by ATKINS [1]) in the English Channel near Plymouth and in the North Sea:

[1]) W. R. G. ATKINS, 1925, Seasonal changes in phosphate contents of sea water in relation to the growth of algal plantation during 1923 and 1924. Journal Mar. Biol. Ass. Vol. XIII. (Cited in: HARVEY, Biological Chemistry and Physics of Sea Water).

	surface	depth	stations of 40 m or more depth surface	depth
Java Sea, April	5.6	8.0	4.7	6.2
„ October	5.6^5	8.1	5.5	7.6
Bay of Batavia, average	5.2^5	6.5	(18 m)	
English Channel	15 - 16	21 - 22	(70 m)	
North Sea, May [1])	11 - 25	15 - 19	(60 m)	

then our impression is confirmed that the Java Sea cannot be counted among the richest seas although we must be cautious in making comparisons: it cannot be denied that the much more rapid metabolism in tropical seas checks such accumulations of nutrient substances as occur in more northern waters during the winter.

On the other hand the P_2O_5-content in northern waters too may get very low and, indeed, may even approach zero at the surface during an outburst of phytoplankton development. No such thing, however, can be observed in the Java Sea. Diatom plankton, as we will see, is found well developed only near the coasts, where, however, the P_2O_5-content is even slightly higher than in the centre of the Java Sea. At by far the majority of the stations the phytoplankton development is quite insignificant. If, nevertheless, no high P_2O_5-values are found, this cannot be taken as an indication of a high fertility of the Java Sea.

One might have expected to find an important addition of phosphate from the influx of fresh water from the many rivers of Borneo and Java. Recent researches, however, tend to show that such water contains only traces of phosphate and that its fertilizing influence on the sea has been greatly overestimated.

Indeed, diagram 6 proves that at the end of the rainy season, in April, the phosphate content of the coast water is only slightly higher than after the dry season, in October.

If, finally, we consider the conditions prevailing in the tropical oceans then we see that the P_2O_5-content here is very low at the surface. During the Meteor-expedition (1925-'27) [2]) the layer 0 - 50 m of the tropical and southern Atlantic proved to contain less than 2 mg/m^3 P = 4⅔ mg/m^3 P_2O_5. In deeper layers a gradual increase is observed in all the oceans until below 200 meters a uniform content of 100 mg/m^3 is attained which remains constant down to a depth of 3000 meters. At the surface the P_2O_5-content increases when approaching the coasts (especially those with constant off-land winds like the

[1]) W. R. G. ATKINS, 1923, The Phosphate Content of Fresh and Salt Waters in its Relationship to the Growth of the Algal Plankton. Journ. Mar. Biol. Ass. Vol. XIII. cf. also: HELGE THOMSON, 1933, The Distribution of Phosphate and Nitrate in the North Sea in May 1932. Rapp. et Proc. Verb. Vol. 85, 3-ième partie.

[2]) E. HENTSCHEL and H. WATTENBERG, 1930, Plankton und Phosphat in der Oberflächenschicht des Südatlantischen Ozeans. Ann. d. Hydrogr. und Maritimen Meteorologie, VIII.

west coast of Africa) and in the polar and sub-polar regions, where vertical convection, as a consequence of the periodical cooling of the surface water in winter, plays a much greater role than in the tropics. Between 40° and 50° S, e.g., the content amounts to 9 - 22 P = 21 - 51 mg/m^3 P_2O_5 and between 50° and 60° S even to 22 - 25 P = 51 - 81 P_2O_5 and higher.

Reverting to the tropics, we see that Orr [1]) in the Barrier Reef lagoon found an average of about 4 mg/m^3 P = fully 9 P_2O_5 throughout the year and at all depths, due to the constant mixing of higher and deeper layers as a consequence of the disturbance of the sea by the wind. His figures, then, are slightly higher than ours for the Java Sea. The Barrier Reef lagoon differs in several respects from the Java Sea (average temperature 25.6° C, annual range 8.6°, average salinity 34.7 ‰, depth 30 - 40 m). The constitution of the plankton, however, seems to show a great likeness to that of the latter.

The volume of the plankton.

A simple, be it a rough, method for estimating the wealth or poverty of a given area of the sea is to determine the volume of the plankton after it has settled at the bottom of the conserving fluid. The reliability of the result is diminished by the fact that some organisms have a relatively much larger volume than others. When a great number of salps, siphonophores, or similar gelatinous organisms is present, very high values will be found. A high volume may be caused also by the presence of large crowds of echinoderm-, or balanid-, or other planktonic larvae of nonplanktonic organisms. This was the case at several stations in Sunda Strait where either echinopluteus or balanid larvae abounded to such an extent that they constituted the greater part of the plankton volume. At other stations, there was a manifest deficiency of plankton and the few planktonorganisms present were in a bad condition, evidently due to some unknown disturbing influence (e.g. in April 1932, nrs. 26 and 27).

The influence of such aberrant cases may be eliminated to a certain degree by comparing and combining a great number of the samples from different localities or collected at different times, or by leaving aside those samples which evidently represent abnormal conditions.

In table I and chart 2 the volumes per m^3 are represented for the successive stations, for the April cruise at the left and for the October cruise at the right side of the route line. We see at once that the highest volumes are found near the coast. This is evident especially on the western route which has its beginning and its end near a river mouth, viz. that of the Tjimanuk of Java and that of the Kumai river of Borneo. It is especially the diatom flora which thrives here. No doubt if a finer meshed net had been used, the volumes near the coast would have been considerably higher still.

Further from the coast the diatoms become scarce or disappear altogether and the zooplankton soon begins to dominate. The volume of the plankton is

[1]) A. P. Orr, 1933, Physical and chemical conditions in the sea in the neighbourhood of the Great Barrier Reef. Great Barrier Reef Exp. 1928-'29, Vol. II nr. 3.

as a rule considerably less here. If e.g. we take out the stations where the depth is 40 m or more, then we find the following averages:

stations 4 - 15	April 0.7^5	October 0.8^5 [1])	cm^3 per m^3.
stations 27 - 32	April 0.6^5	October 1.1^5	cm^3 per m^3.
General average for	April 0.7^1,	October 0.9^5	cm^3 per m^3.
General average for both cruises 0.8^3 cm^3 per m^3.			

Considerably more would have been caught, no doubt, if a net of finer plankton gauze, e.g. nr. 20, as in the medium APSTEIN net, had been used. Sunier e.g. found for the average of 15 plankton hauls with such a fine-meshed net in the Java Sea, all made at a distance of no less than 45 miles from the coast, 2.6 cm^3 per m^3, i.e. fully 3 times as much.

After my return to Holland, Dr. HARDENBERG has, at my request, made a number of double hauls, with the HENSEN's egg net (gauze nr. 3) and the medium APSTEIN net (gauze nr. 20) resp., in order to find out with which factor the catches of the former ought to be multiplied to be comparable with those of the latter. This factor, however, proved to be variable and, as might be expected, to depend upon the composition of the plankton. The fine coast plankton of course, passes in much greater quantity through the meshes of the coarser net than plankton consisting of bigger organisms as found in the middle of the Java Sea. In the former case the multiplication factor will prove to be higher than in the latter. This it seems practically impossible, by applying a uniform correction to my catches, to make them comparable to those made with the gauze nr. 20 or 25 e.g. in European waters, or elsewhere, e.g. during HENSEN's plankton-expedition in 1889.

This is very much to be regretted and I hope that my successors in Batavia will have the opportunity of completing my observations by making a number of hauls with the medium APSTEIN net, gauze nr. 20, which arrived at the Batavia Laboratory only after my return to Holland. The few catches made for me by Dr. HARDENBERG with this net seem to point even rather to a higher than to a lower average volume than found by SUNIER.

During the years 1910 - 1911 I made weekly plankton observations from the light ship "Haaks" in the North Sea near Den Helder. This light ship lies at a distance of 28 km from the coast, the depth of the sea being 27 m there. The average volume of the plankton fished with the medium APSTEIN net was for the year 8.V.1910 - 8.V.1911 [2]) 200 cm^3 under 1 m^2, i.e. about 8 cm^3 per m^3 or slightly less. This average in considerably higher than that found by SUNIER for the Java Sea but, as observed above, I have found higher values too, so that it seems better to delay drawing conclusions until more data relating to the Java Sea are available.

[1]) The values for stations 11 - 13 evidently being abnormally high, due to the presence of many salps, siphonophores etc., I have corrected these by reducing them to 1 cm^3 per m^3 which still is higher than the average quantity found above.

[2]) For the year V.1911 - V.1912 it was considerably higher which, however, was due to the exceptionally warm summer of 1911 making this year abnormal.

SUNIER himself compares his result with those obtained by Mielck in February and May 1906 in the North Sea and which were considerably lower than my yearly average for the "Haaks", being 1.3 and 3.2 cm^3 resp., so that this does not compare at all unfavourably with the Java Sea, especially if we take into account that the Mediterranean near Naples and the Sargasso Sea yielded average catches of 16 and 30 - 33 cm^3 resp. under 1 m^2. The former figure refers to vertical hauls of 100 (as a matter of fact made mostly in winter!), the latter to vertical hauls of 200 - 0 m. These figures would be lower still — though, probably, not proportionately — if hauls of 50 m had been made. Indeed SCHÜTT [1]) gives in his tables 13 a few hauls of 50 - 0 m in the Bay of Naples which yielded an average catch of 13 cm^3 under 1 m^2 = 0.26 cm^3 per m^3. KRÄMER [2]) who centrifuged the contents of the HENSEN's plankton net found in the Pacific, going from Samoa via the equator to the Marshall Islands, from 0.4 - 0.9^5 cm^3 per m^3 (hauls mostly of 100 - 0 m). On the other hand the same author found with the same method near Kiel in the Baltic 1.9 - 11 cm^3 per m^3. And during the Plankton Expedition catches were made in northern waters (Irminger Sea) of more than 1600 cm^3 under 1 m^3 in hauls of 200 - 0 m, which, if we assume that most of this plankton is present in the uppers, would answer perhaps to 800 cm^3 in a haul of 50 m or 16 cm^3 in 1 m^3.

SUNIER's average of 2.6 cm^3 per m^3 seems to keep the due medium between these extremes and we might conclude that the Java Sea, though not so rich as northern seas, yet contains more plankton than the tropical oceans generally. But comparisons are difficult, in one case the hauls have been made mostly in winter, i.e. the poor season of the northern hemisphere (Naples!), in the other case they have been made in summer only (Irminger Sea); in one case the plankton has been left to subside whereas in the other case it has been centrifuged. For a comparison of a northern sea with a tropical sea (e.g. North Sea with Java Sea) we would require in the former case an annual average based on a series of observations distributed regularly over the whole year (to eliminate the influence of the seasons) and, preferably over a number of stations; further absolutely similar fishing methods und measurement in both cases. These conditions not yet being fulfilled, it seems advisable to be careful in drawing conclusions regarding the relative plankton wealth of e.g. the North and the Java Sea.

If we compare the catches of October, at the end of the east monsoon with those of April, at the end of the west monsoon, then we find the volume of the former higher. The average volume of the 30 October catches is 2.2^5 cm^3 per m^3, that of the April catches 1.3 cm^3. Even taking into consideration that the October catches nrs. 11 - 13 had a relatively high volume due to the presence of a good deal of salps, siphonophores etc. and, on this account, applying a correction to the October average, then still we find the latter to be fully 1½ times as large as the April average.

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[1]) F. SCHÜTT, 1892, Analytische Planktonstudien.
[2]) A. KRÄMER, 1906, Ergebnisse meiner Korallenriff- und Plankton-studien.

For the stations deeper than 40 m the difference is slightly less (averages 0.71 and 0.95 resp. cf. above) which is caused especially by the stations of the western route. For the coast stations, therefore, the difference must be greater. However, the differences are too small to warrant far reaching conclusions. Other years may yield other results again and it is advisable to await further observations. Provisionally we can state only that the differences seem not very considerable.

Phytoplankton.

According to its general composition we might divide the plankton of the Java Sea into the following types:

1° diatom plankton
2° animal plankton
3° mixed phyto- and zooplankton
4° *Trichodesmium*-plankton.

The diatom plankton was generally found along the coasts, whereas the zooplankton predominated in the middle of the Java Sea, where often diatoms are practically absent but where *Trichodesmium* may appear. The coast plankton in general is of a finer composition, containing, besides diatoms, only smaller copepods, such as those belonging to the first group on p. ???.

I sent, in 1929, a number of phytoplankton samples from the coasts of Java, Borneo and Sumatra to Mr. W. E. ALLEN and Miss E. E. CUPPS, of the Scripps Institution at La Jolla, Cal. U.S.A. They kindly undertook to examine these samples and to write a treatise on the diatoms contained in them. Unfortunately the publication of this essay was delayed in consequence of the great economical depression from 1929 onwards, but in the year 1935 the paper was printed [1]). This valuable and richly illustrated treatise will be of great help to every student of the marine diatoms of the Indian seas, as it has been to me.

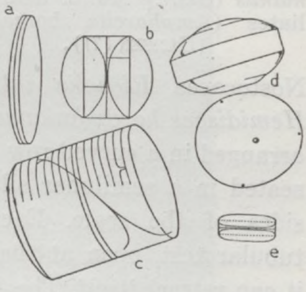

Fig. 1. a. *Coscinodiscus gigas* var. *praetexta*; b. *C. jonesianus*; c. *C. nobilis*; d. *C. jonesianus* var. *tenuis* MEISTER?; e. *C. janischii*?

Although the number of species is great — and would, no doubt, be increased still by further researches — yet a restricted number only may be said to play a more or less predominant role in the plankton catches or in part of them. And on the whole the same species found by ALLEN and CUPP to dominate in the relatively few catches I sent to them were found by me, too, to be most common in my samples. I give here two tables [2]) of their occurrence, one for the April cruise, the other for the October cruise, and containing only the commoner species. The indications c (common), + (present) and r (rare) rest on personal estimates, not on countings. Countings, in using catches made by such a coarse-meshed net, would

[1]) W. E. ALLEN and E. E. CUPP, 1935, Plankton Diatoms of the Java Sea Ann. Jardin Botan. de Buitenzorg, Vol. XLIV.
[2]) See page 176 - 177 and 178 - 179.

not have been sufficiently reliable to repay the considerable trouble connected with them.

True diatom plankton, in which the diatoms dominate, is found only in a very few of my samples and, indeed, is almost confined to stations 1 and 2 in April and station 2 in October, an to station 33 (c.q. also 34) in both months. Further away from the Java coast the diatoms rapidly diminish in number, finally to practically disappear.

Also under the Borneo coast an increase of the number of diatoms may be observed but the belt seems to be less narrow here and less confined to the close neighbourhood of the coast. As a matter of fact, the shallow water and the lower salinities reach here much further than under the Java coast.

As a rule species of *Rhizosolenia, Chaetoceras* and *Coscinodiscus* dominate in the coast plankton. Not only the number of individuals but also the number of species belonging to these genera increase in the neighbourhood of the coast.

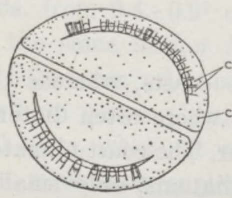

Fig. 2. *Hemidiscus hardmanianus* (GREV.) Mann. with ciliates (*Amphorella borealis*) (HENSEN (?)).

As SUNIER has observed already, the common *Chaetoceras coarctatum* is hardly ever found without a more or less considerable number of an epiplanktonic *Vorticella* on it, whereas the bigger *Rhizosolenia's* nearly always contain in their cells a number of short threads of the Nostocacea *Richelia intracellularis*. A curious symbiosis exists also between *Hemidiscus hardmanianus* and a small Ciliate. A number of the latter is found arranged in a curved row on the scale of the former, seated in a semilunar silt on each of the two flat sides of the scale. Each ciliate has a hyaline, tubular test, open at the upper end and in which it can retract itself. The *Hemidiscus*, however, may be found also without these occupants and in this case no trace of the semilunar slits can either be observed, so that one gets the impression that they are formed only under the influence of the presence of the Ciliates. Truly, if we study a sample with profits in state of division, we see that on the new valves the semilunar slits are present before the ciliates have occupied them. It would be worth while, no doubt, to make a closer study of this symbiosis.

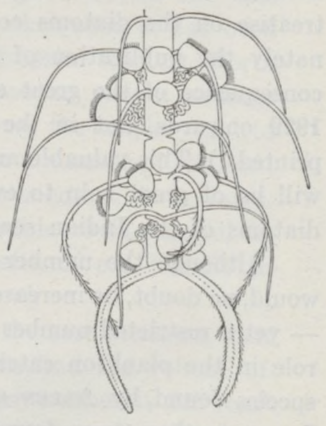

Fig. 3. *Chaetoceras coarctatum* LANDER, with *Vorticella's*.

Mr. ALLEN draws my attention to the fact that it has been observed first by OSTENFELD [1]) who gives a figure and says: "Curious is a curved fissure on the valves; in most specimens which I have seen this

[1]) JOHS. SCHMIDT, Flora of Koh Chang, Part VII, Marine Plankton Diatoms, by C. H. OSTENFELD, Botanisk Tidsskrift, Bd. 25, 1902.

fissure was a place of refuge for a little protist, probably an *Amphorella borealis* (HENSEN) Dad., var. nov.; the small, more or less numerous, organisms were fixed to the inner side of the fissure".

One species of diatom was never wholly absent from the catches. It was the flat, disc-shaped *Coscinodiscus gigas* which really also had its maximum near the coast, together with the other species of diatoms. But whereas the latter were often practically absent in the middle of the Java Sea, *Coscinodiscus gigas* might be rare but never was wholly absent.

Comparing the table for April with that of October, we get the impression that in April, at the end of the west monsoon, diatoms are more numerous on the western route than on the eastern, whereas in October, at the end of the east monsoon, the difference seems less evident.

I have made few observations on Peridinians which rarely were abundant and which, moreover, were caught only very incompletely by the wide meshes of my net. *Ceratium tripos, fusus, macroceros* and other species known from northern waters may be found now and then. *Ceratium fusus* was once found in great quantity in the mouth of the Kumai-river, together with *Noctiluca*. The salinity here was only 17.4 ‰.

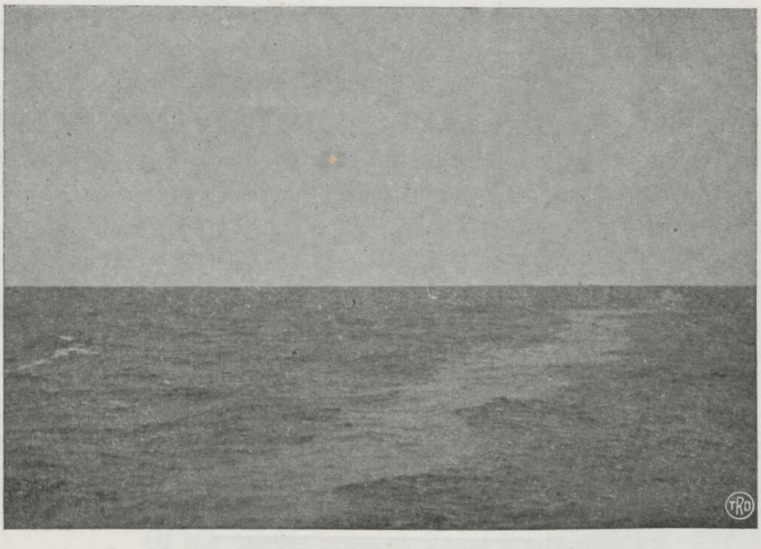

Fig. 4. Yellow strip of *Trichodesmium*.

Trichodesmium spp. and related Schizophyceans (a.o. *Katagymene* which, however, as SUNIER observes, is not common) are found nearly always at a certain distance from the coast. They seem to avoid the more or less brackish coast water and only where this is not present, as e.g. in the narrowest part of Sunda Strait with its strong tidal currents, did I see *Trichodesmium* close to the shore. At certain places it may become very abundant and the small bundles, gathering at the surface, may occur in such quantities that they remind one of sawdust, colouring the sea a brownish-yellow. More or less broad bands

of the sea surface may seem coloured in this way and these bands, as a rule, appear to run at a good distance from the coast (often several tens of miles)

Fig. 5. Planktondiatoms from the Java Sea.

1. *Bacteriastrum hyalinum*; 2. *Biddulphia sinensis*; 3. *Rhizosolenia styliformis*; 4. *Rhizosolenia styliformis* var. *latissima*; 5. *Chaetoceras peruvianum*; 6. *Chaetoceras lorenzianum*; 7. *Coscinodiscus jonesianus*; 8. *Ditylum sol*; 9. *Stephanopyxis palmerina*; 10. *Cerataulina bergonii*; 11. *Bellerochia malleus*; 12. *Rhizosolenia setigera*; 13. *Rhizosolenia calcar avis*; 14. *Rhizosolenia stolterfothii*; 15. *Chaetoceras denticulatum*; 18. *Rhizosolenia alata* forma *genuina*; 19. *Rhizosolenia alata* forma *indica*; 20. *Rhizosolenia clevei*; 21. *Streptotheca indica?*; 22. *Hemidiscus hardmanianus*; 23. *Lauderia annulata*; 24. *Chaetoceras pseudocurvisetum*; 25. *Rhizosolenia arafurensis*; 26. *Rhizosolenia imbricata* (*shrubsolei*); 27. *Rhizosolenia robusta*; 28. *Hemiaulus sinensis*; 29. *Thalassiothrix frauenfeldii*.

and parallel to the latter. They may have a length of many miles and once, indeed, we have followed such a *Trichodesmium* band with our investigation-vessel for half a day, steaming east-west parallel to the north coast of Java until night drawing near forced us to give it up. From some distance away such a *Trichodesmium* zone may be signalized by the calmer water there and by a rather strong smell of chlorine.

Quite near the coast, in more or less brackish water, *Noctiluca miliaris* may be present in great quantity. A peculiarity of the tropical *Noctiluca* is the presence of a large number of small green flagellates in the specious vacuoles, as first stated by the WEBER's [1]) who, however, did not observe living material. If we do so, we find that these small green organisms of which hundreds, perhaps even thousands, are present in each *Noctiluca*-cell do not be still there but are swimming vigorously about in the fluid which fills up the spacious vacuoles. As observed by the WEBERS [1]), the green colour caused by the presence of the flagellates is quite evident where accumulations of *Noctiluca* at the surface of the water occur.

The occurrence of *Noctiluca* is restricted to coastal and even to slightly brackish water, so that it is never found at some distance from the coast.

Copepods.

For the sake of convenience we might subdivide the copepods into three groups, according to the length, viz.

1° those reaching a length of more than 2 mm

2° the medium-sized, between 1 and 2 mm

3° those smaller than 1 mm.

The numbers of these three groups are by no means evenly spread over the area investigated, as will be shown.

Fig. 6. *Temora stylifera* ♂.

To those smaller than 1 mm belong such forms as: *Oncaea conifera* GIESBRECHT a.o. *Corycaeus venustus* DANA and other small *Corycaeus* species, *Euterpina acutifrons* (DANA), *Oithona rigida* GIESBRECHT, *Clytemnestra scutellata* DANA, *Microsetella* spp.

Of the species between 1 and 2 mm mention *Temora discaudata* GIESBRECHT and *stylifera* DANA, *Centropages furcatus, Oithona plumifera* BAIRD, *Tortanus gracilis* (BRADY), *Calanopia elliptica, Pontellina plumata* (DANA), *Pontellopsis krameri* (GIESBRECHT), *Paracalanus aculeatus* GIESBRECHT, *Canthocalanus pau-*

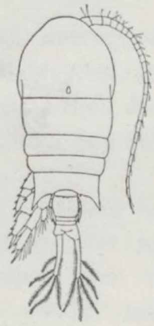

Fig. 7. *Temora discaudata* ♀.

[1]) M. WEBER and A. WEBER-VAN BOSSE, 1890, Quelques nouveaux cas de Symbiose.
Zoöl. Ergebn. einer Reise in Niederl. Ost Indien, I.

per (GIESBRECHT), *Acrocalanus gibber* GIESBRECHT, *Candacia* spp. *Acartia pietschmanni, pacifica* a.o.

Fig. 8. *Temora discaudata* ♂.

The third group, containing the copepods of more than 2 mm, comprises in the Java Sea a restricted number of species only, viz. *Undinula vulgaris* (DANA), *Eucalanus subcrassus* GIESBRECHT, *Euchaeta concinna* DANA, *Candacia bradyi* A. SCOTT, *Labidocera acuta* (DANA) and *Pontella securifer* BRADY. The latter, though fairly widely distributed, was never found in any considerable number, and in the same way a few other species reaching a length of 2 mm or more can only be observed now and then. Only five species, however, may be present more or less plentifully, as far as my observations reach. Many species and genera occurring in the surrounding oceans, and e.g. in Sunda Strait, were not met with in the Java Sea. Thus the genera *Pleuromamma, Euchirella, Undeuchaeta,* each represented by several fairly big species in the Sunda Strait plankton, were absent in the Java Sea which, of course, doesnot exclude the possibility that they will ever be found there.

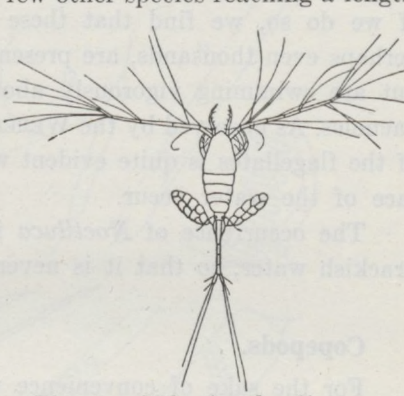

Fig. 9. *Oithonia plumifera.*

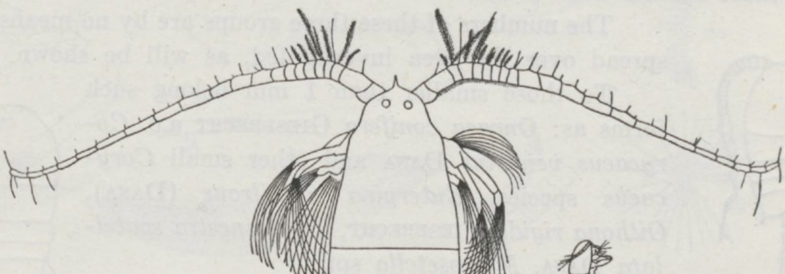

Fig. 10. *Labidocera acuta* ♀.

My egg-net catches are especially suitable for studying the distribution of the bigger species, as the mouth of the net is sufficiently wide to catch a good number of individuals, whereas the width of the meshes does not allow any to escape as is the case with smaller forms and with young stages.

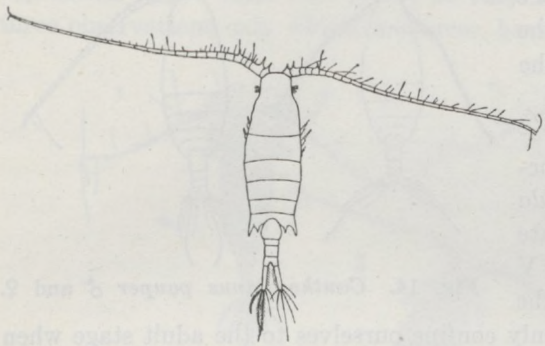

Fig. 11. *Centropages furcatus* (DANA).

The biggest of the five Java Sea species are *Undinula* (formerly *Calanus*) *vulgaris* and the blue *Labidocera acuta*, both reaching a length of 3 mm. The former, however, was much more widely distributed and occurred in greater numbers than the latter. Especially the female *Undinula vulgaris* is the biggest common copepod in the Java Sea and must be highly appreciated as food by the plankton-feeding pelagic fishes whose stomachs are often filled with them. Perhaps its role might even be compared with that of *Calanus finmarchicus* in northern seas, although the latter is still a good deal bigger (length ♀ 3 - 5 mm). But the same can be said of many northern fishes: the northern herrings, mackerel, anchovies, tunnies and flatfishes are on an average all bigger than their tropical, and certainly bigger than their Java Sea and South China Sea relatives.

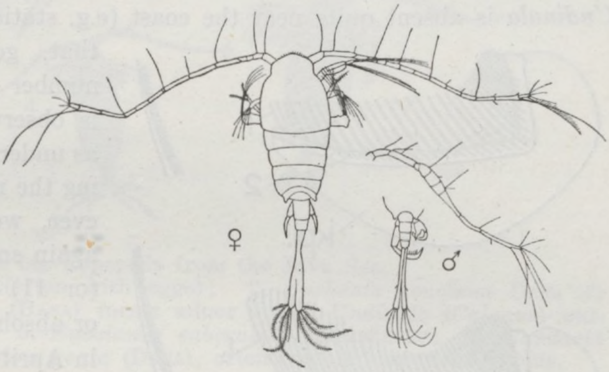

Fig. 12. *Tortanus gracilis* ♀ and ♂.

The male of *Undinula vulgaris* is slightly smaller and easily distinguished from the female by the caudal setae being directed perpendicular to the longitudinal axis of the animal, and by the absence of the paired spines into which the last thoracic segment of the female is produced. The former

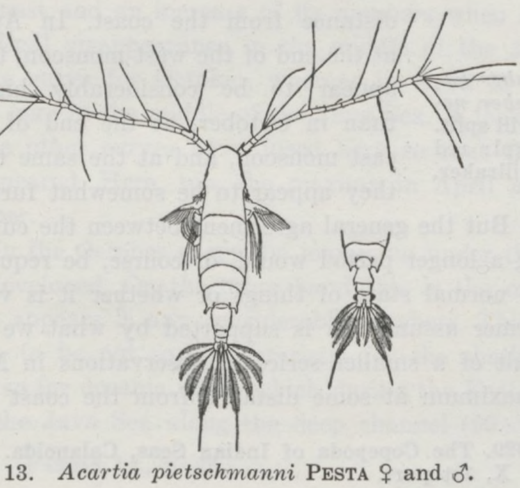

Fig. 13. *Acartia pietschmanni* PESTA ♀ and ♂.

characteristic is not quite so not quite so reliable as the latter, as sometimes males are found with the caudal setae directed backwards in the same way as with the female. But in this case the enormous prehensile leg of the male renders it easy to recognize the species.

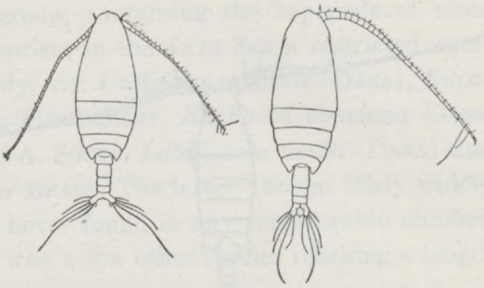

Fig. 14. *Canthocalanus pauper* ♂ and ♀.

SEYMOUR SEWELL [1]) has elaborately described and measured the successive copepodid stages of *Undinula vulgaris*. His observations indicate that already the copepodid stage V may reach (♂) and surpass (♀) the 2 mm-limit. We will, however, mainly confine ourselves to the adult stage when studying the distribution of this species in the Java Sea.

In charts 3 and 4 the distribution of the adult *Undinula vulgaris* in the Java Sea in April and in October resp. are represented. Both charts show that *Undinula* is absent quite near the coast (e.g. stations 1, 2, 3, and 20, 21) and that, going seaward, we see the number increase. This phenomenon is observed as well under the Java as under the Borneo coast. Approaching the middle of the Java Sea, however, we see the number decrease again so that e.g. at the stations 10 (or 11) - 14 *Undinula* is practically or absolutely absent, and this as well in April as in October. Most evident is this phenomenon on the western route passage, stations 1 - 21. The maxima are found at a certain distance from the coast. In April, at the end of the west monsoon, they appear to be considerably higher than in October, at the end of the east monsoon, and at the same time they appear to be somewhat further from the coast in the latter case. But the general agreement between the curves is evident. Observations covering a longer period would, of course, be required to make out whether this is the normal state of things or whether it is valid only for the year 1932. The former assumption is supported by what we see in chart 8 which shows the result of a smaller series of observations in May 1934. Here we find again the maximum at some distance from the coast and

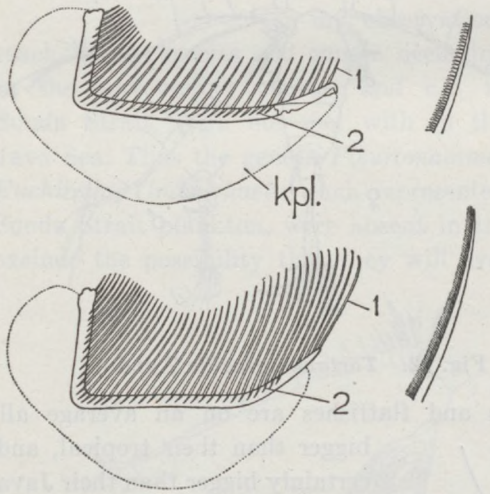

Fig. 15. Above: gill sieve of *Scomber kanagurta*; below: gill sieve of *Scomber neglectus*, × 1. 1. Gillrakers of first gill split. 2. Gillrakers of second gill split. kpl: red gill lamellae. To the right: One gillraker.

[1]) R. B. SEYMOUR SEWELL, 1929. The Copepoda of Indian Seas, Calanoida. Memoirs of the Indian Museum, Vol. X, 1st part.

the same gradual decrease and final disappearance of *Undinula* if we proceed to the middle of the Java Sea. Whether also the left fig. on this chart is the expression of the same rule is not so easy to decide as this series consists of three observations only which, moreover, have not been made at the same time.

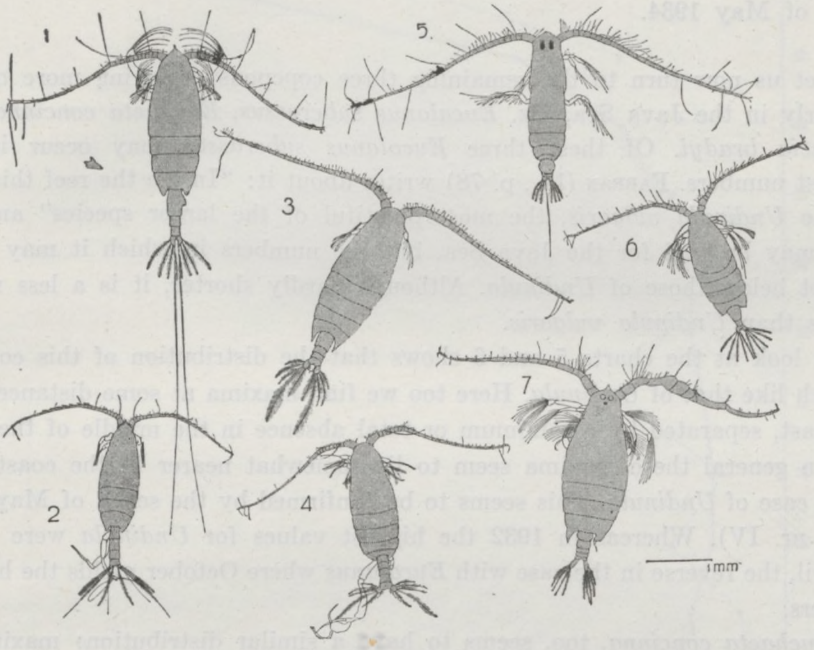

Fig. 16. Five big Copepods from the Java Sea.
1. *Euchaeta concinna* DANA ♀ (often with eggs); 2. *Euchaeta concinna* DANA ♂; 3. *Undinula* (*Calanus*) *vulgaris* (DANA) forma minor ♀; 4. *Undinula* (*Calanus*) *vulgaris* (DANA) forma minor ♂; 5. *Eucalanus subcrassus* GIESBRECHT; 6. *Candacia bradyi* A. SCOTT; 7. *Labidocera acuta* (DANA), often coloured beautifully blue.

For the eastern half of the Java Sea things are not so easily brought under this rule. Here, too, we find a minimum or absence of *Undinula* near the coast and an increase of its numbers when going seawards. But a decrease and final disappearance in the middle of the Java Sea can be observed only in the curve for October, whereas in April it was quite absent, the maxima lying here in the middle of the Java Sea. It looks as if the two maxima present in the other curves have fused here so that the minimum in the centre has disappeared. Here, too, the maxima in April are higher again than those in October.

In the October curve the maximum under the Java coast seems practically not developed. On the other hand this is the only occasion where *Labidocera acuta* appears in any considerable numbers. This beautiful blue copepod seems to me to be not so characteristic for the shallow Java Sea as *Undinula* but more so for oceanic water which during the East monsoon may have penetrated into the Java Sea along the deep channel (60 - 70 m) in the middle of which

[1]) FARRAN l.c., p. 75.

the isle of Bawean is situated. One gets the impression that *Undinula* is replaced here more or less by *Labidocera acuta*. FARRAN [1]) really counts *Labidocera acuta* among the coastal species, to which practically all the Java Sea species belong. As shown by table IV it was present also at several stations of the series of May 1934.

Let us now turn to the remaining three copepods occurring more or less regularly in the Java Sea, viz. *Eucalanus subcrassus, Euchaeta concinna,* and *Candacia bradyi.* Of these three *Eucalanus subcrassus* may occur in the greatest numbers. FARRAN (l.c., p. 78) writes about it: "Inside the reef this was, next to *Undinula vulgaris,* the most plentiful of the larger species" and the same may be said for the Java Sea, but the numbers in which it may occur are not below those of *Undinula.* Although hardly shorter, it is a less robust species than *Undinula vulgaris.*

A look at the charts 5 and 6 shows that the distribution of this copepod is much like that of *Undinula.* Here too we find maxima at some distance from the coast, separated by a minimum or total absence in the middle of the Java Sea. In general these maxima seem to lie somewhat nearer to the coast than in the case of *Undinula.* This seems to be confirmed by the series of May 1934 (table nr. IV). Whereas in 1932 the highest values for *Undinula* were found in April, the reverse in the case with *Eucalanus* where October yields the highest numbers.

Euchaeta concinna, too, seems to have a similar distribution: maxima at some distance from the coast, as is evident especially on the western route and somewhat better developed in April than in October.

Candacia bradyi differs from the other bigger copepods in that it is present also in the middle of the Java Sea, indeed, is only absent in a few catches, although not always being represented by individuals of 2 mm or more, a size reached only by fullgrown specimens.

As regards the distribution of the middle sized and the smaller species of copepods our results with the wide meshed net are, of course, less reliable, as part of them, and especially of the latter, may escape through the meshes. Diagram 7 and 8 and chart 2 show us the total number of copepods found in 1 m^3. We see the number increase in the neighbourhood of the coasts. In reality the gradient of this increase must be steeper still than indicated in chart 2 and 8 as 1° the coast stations lie nearer to each other than those in the middle of the Java Sea, whereas in diagrams 7 and 8 the distances are all alike, and 2° the coast plankton contains the highest number of small species, part of which will get lost by the wideness of the meshes.

Of course the number of copepods is no measure for the quantity of copepod material present in a catch as e.g. one *Undinula vulgaris* or *Labidocera acuta* may perhaps have the same weight as 100 *Euterpina acutifrons* from near the coast.

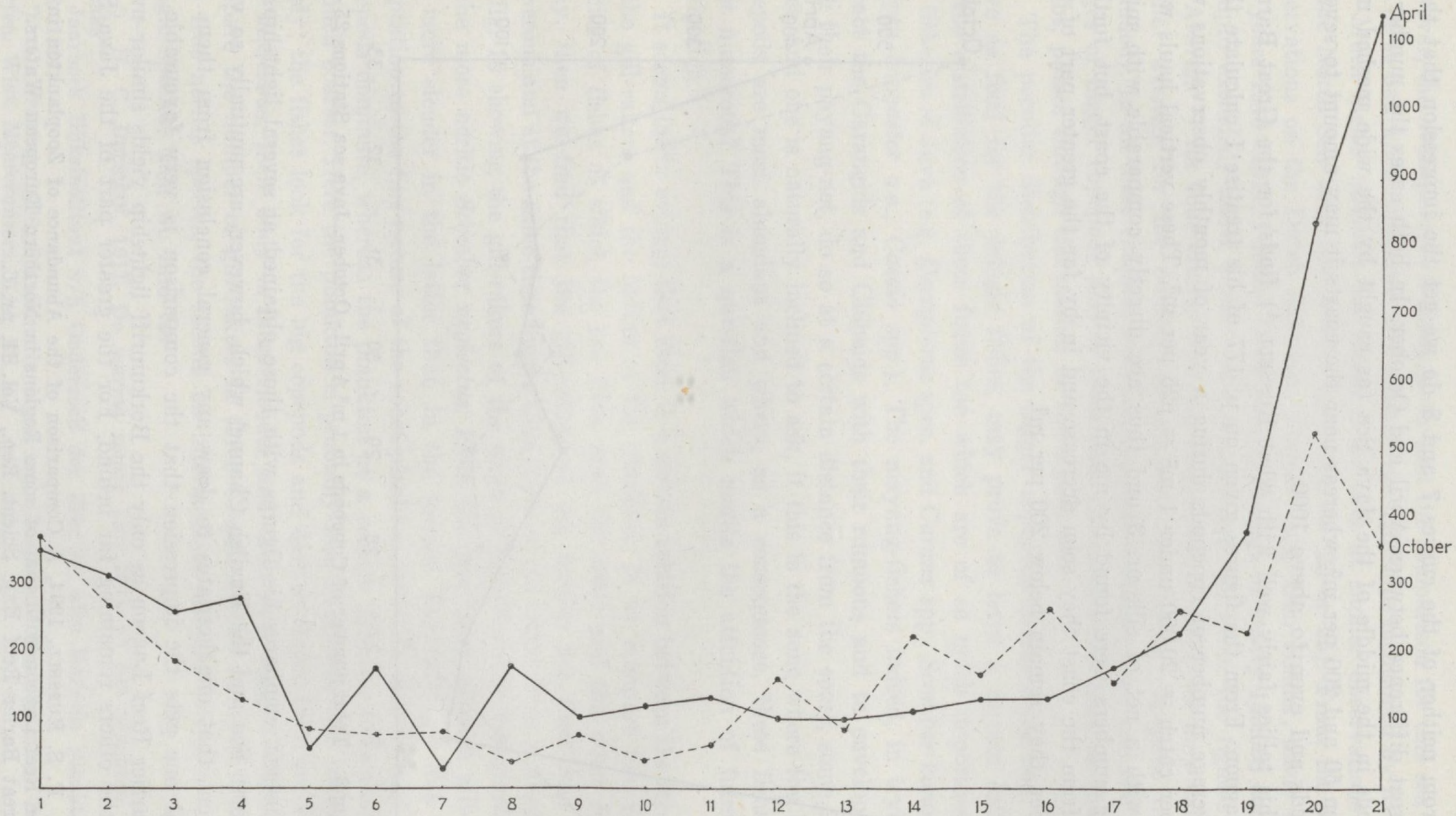

Diagram 7. Total number of Copepods in 1 m³ April - October. Javasea. Stations 1 - 21.

From neither of the curves 7 and 8 do we get the impression that there is a great difference between April and October. In both cases the number of copepods in the middle of the Java Sea (as caught by the wide meshed net) between 50 and 200 per m^3, whereas near the coasts it may amount to several hundreds and even to above 1000.

This tallies fairly well with what RUSSELL [1]) finds for the Great Barrier Reef lagoon. From the figures given on p. 177 of his treatise I calculate that the average number of copepods during a year of monthly observations was 4000 per catch = 20.000 under 1 m^2 = 625 per m^3. These vertical hauls were made with a net of silk nr. 3 and thus are directly comparable with mine. Similar numbers were found by me in the vicinity of the coast, but further away from the coast they soon decrease and in by far the greater part of the Java Sea they remain below 200 per m^3.

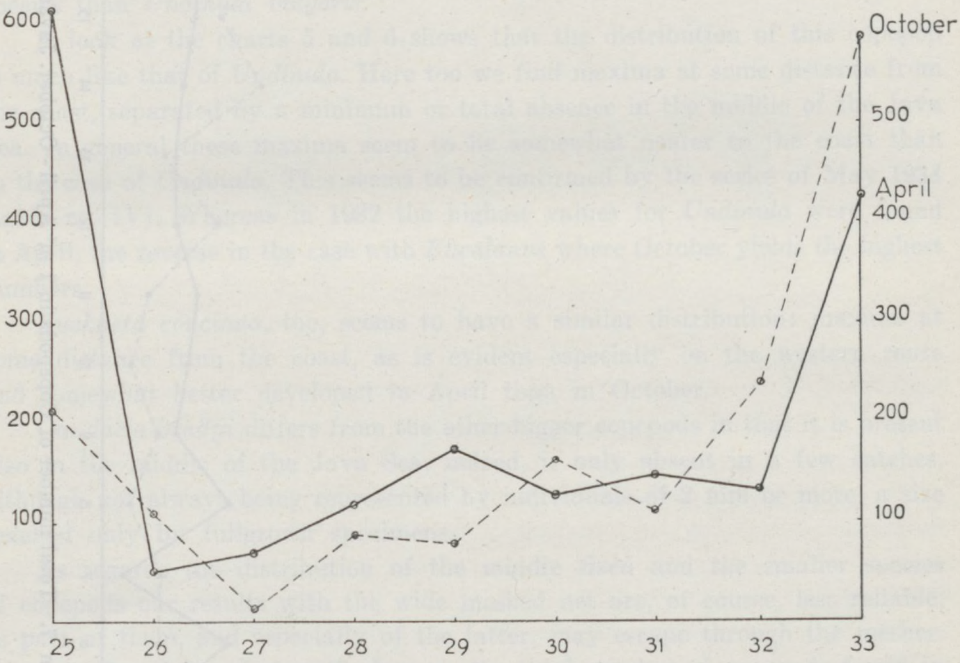

Diagram 8. Total number of Copepods in 1 m^3 April - October. Java sea Stations 25 - 33.

RUSSELL compares his figures with those obtained at several lightships in the North Sea and the English Channel which, however, are mutually so very divergent that one hesitates to draw any general conclusion from them. In general one gets the impression that the comparison is very favourable for the Barrier Reef Lagoon as only the Borkumriff lightship yields similar numbers, the others remaining far behind. For the greater part of the Java Sea,

[1]) F. S. RUSSELL, 1934, A Comparison of the Abundance of Zooplankton in the Barrier Reef Lagoon with that of some Regions in Northern European Waters. Great Barier Reef Exp. Scient. Rep., Vol. II, nr. 6.

however, the average is 4 - 5 times lower and the comparison for this sea would not be so bad when compared with most of the lightships mentioned by RUSSELL.

Much higher numbers are found if we look at similar observations made in the North Sea with fine meshes nets (silk nr. 20 or 25). From the weekly observations on the Dutch lightship "Haaks" near Den Helder, made during the years 1910 - 1911, I found [1]) an annual average of nearly 150.000 copepods (nauplii excluded) under 1 m^2 = about 5500 per m^3. From the figures given by APSTEIN [2]) for four cruises over the North Sea in 1906, we may calculate similar average for the number of copepods and young copepods (nauplii excluded). In all these catches, however, the small *Oithona nana* and the young stages of bigger copepods play a great rôle. A considerable part of them, no doubt, passes through the meshes of the coarse net.

The peculiar distribution of the bigger copepods in the Java Sea, which serve as food for the pelagic fishes, may prove to have a certain influence on the distribution of these fishes too which are of so much importance for the fisheries of Java (e.g. *Decapterus* spec. and *Caranx* spp., *Scomber kanagurta, Clupea leiogaster* o.a., *Caesio* spp.). The mayang-fishers indeed, in trying to attract the Carangids and Clupeids with their rumpons and to envelop them with their payang-net, do so at a certain distance from the coast, some 25 - 40 miles, and one is naturally inclined to ask, if this is the zone where the bigger copepods are most abundant and where, as a consequence, these fishes are most numerous? This is a question which merits the attention of future investigation.

It seems fairly evident that there is a certain relation between the structure of the gill-rakers and the nature of the plankton. It we compare two related species of fishes of which the one lives near the coast and the other further away, then we find that the gill-rakers of the former are finer and more numerous and at the same time longer than those of the latter. This is illustrated by fig. 16 showing the gill-rakers of the more pelagic *Scomber kanagurta* and of the more neritic *Scomber neglectus*. Even the fine hairs of each gill-raker are more slender in the latter than in the former. Evidently all this is an adaptation to the fine nature of the coast plankton in which diatoms and small copepods dominate, whereas the plankton at a certain distance from the coast is much coarser. Here the plankton is probably also swallowed less indiscriminately; the fishes look for the big copepods and dart at them; they are swiffer and dexterous, their body is more slender and their eyes bigger. Thus if we compare the number of gill-rakers in three *Clupea*-species of which the first is a true neritic species, the second an intermediate and the last one a more pelagic species, then we find for

[1]) H. C. DELSMAN, 1911, De warme zomer van 1911 en het plankton bij de „Haaks".
Jaarboek Rijksinstituut v/h Onderzoek der Zee; cf. also Bulletin Planktonique 1908 - 1911.

[2]) C. APSTEIN, 1906, Plankton in Nord und Ostsee auf den deutschen Terminfahrten. Wiss. Meeresunters. Kiel, Bd. 9.

	nr. of gill-rakers on lower half of first gill arch.	length of gill-rakers.
Clupea kanagurta (m a t a b ě l o)	88	$1^1/_3 \times$ diameter of eye.
Clupea fimbriata (t e m b a n g)	50	$^3/_5$ - $^3/_4 \times$ „ „ „
Clupea leiogaster (l e m u r u)	30	$^1/_2 \times$ „ „ „

The higher the number of gill-rakers, the greater their length and the smaller the diameter of the eyes, so that the ratio length of the gill-rakers: diameter of the eye is in this case especially suitable for distinguishing the species.

Other zoöplankton.

Of the further components of the zoöplankton I mention first the Crustaceans. The following species of Schizopods have kindly been identified by Prof. TATTERSALL, of Cardiff:

Euphausiacea: *Pseudeuphausia latifrons* (G. O. SARS), closely related to *Nyctiphanes*. In the Barrier Reef report TATTERSALL [1]) says about this species: „......is a shallow-water coastal form, quite widely distributed in the Pacific, but always near to land. and never under oceanic conditions. This species is the dominant one ......of the shallow lagoon area inside the reef". In the Java Sea we see it appear only at a certain distance from the coast, in the same way as the big copepods. In the series of May 1934 e.g. it had its maximum at station 16, i.e. one or twe stations further away from the coast than the big copepods.

Mysidacea: *Anchialina typica* KRÖYER, according to TATTENSALL "one of the most characteristic species of the Barrier Reef Lagoon". Another species

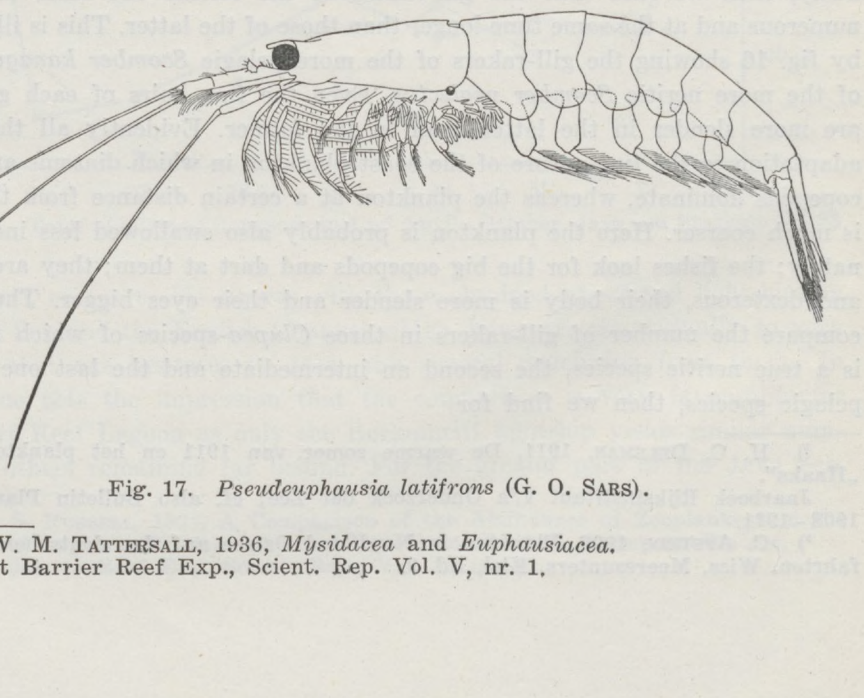

Fig. 17. *Pseudeuphausia latifrons* (G. O. SARS).

[1]) W. M. TATTERSALL, 1936, *Mysidacea* and *Euphausiacea*. Great Barrier Reef Exp., Scient. Rep. Vol. V, nr. 1.

of *Anchialina* could not be identified with any previously described species and will probably prove new.

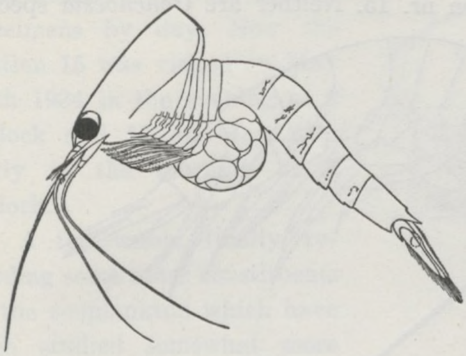
Fig. 18. *Anchialina typica* KRÖGER.

Hemisiriella parva H. S. JANSEN.

Gastrosaccus indicus H. J. JANSEN (?, immature specimens only).

Leptomysis xenops TATTERSALL.

These species were found at the stations 16 and 15 of the above series and had their maximum at station nr. 15, being still one station further from the coast than *Pseudeuphausia latifrons*.

A number of Amphipods too could be found now and then at the stations somewhat further from the coast. One of the biggest in the Oxycephalid *Tull-*

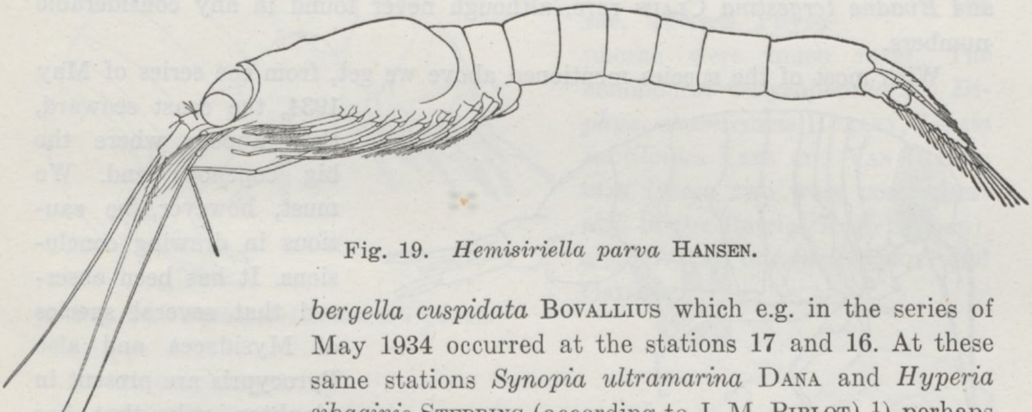
Fig. 19. *Hemisiriella parva* HANSEN.

bergella cuspidata BOVALLIUS which e.g. in the series of May 1934 occurred at the stations 17 and 16. At these same stations *Synopia ultramarina* DANA and *Hyperia sibaginis* STEBBING (according to J. M. PIRLOT) [1]) perhaps a subspecies of *Hyperia schizogeneios* STEBBING) were present, together with *Simorhynchotus antennarius* (CLAUS), *Parascelus edwardsii* CLAUS (= *zebu* STEBBING) and *Hyperia dysschistus* STEBBING.

Xiphocephalus whitei was found now and then only, single or in small numbers.

Very common in the plankton is often the slender Sergestid *Lucifer intermedius* HANSEN which in the series of May 1934

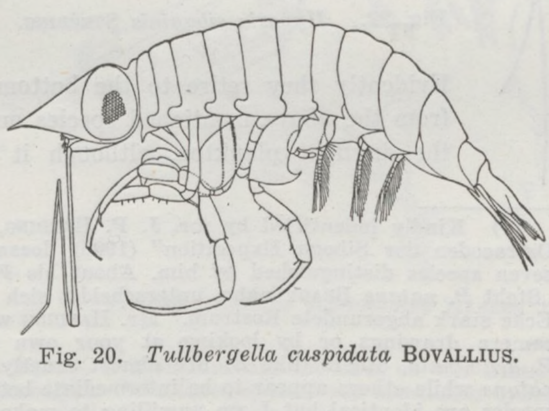
Fig. 20. *Tullbergella cuspidata* BOVALLIUS.

[1]) J. M. PIRLOT, Siboga Exp.

had its maximum at station no. 15, the Ostracod *Pyrocypris natans* (BRADY [1]) which also has its maximum at station nr. 15. Neither are *Conchoesia* species

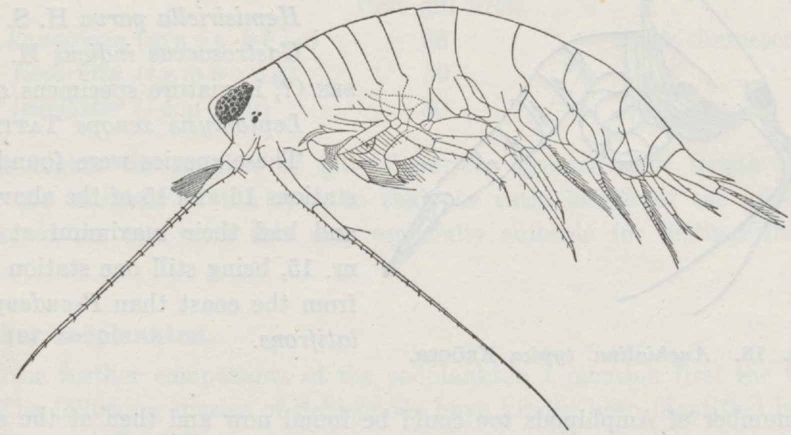

Fig. 21. *Synopia ultramarina* DANA.

and *Evadne tergestina* CLAUS rare, although never found in any considerable numbers.

With most of the species mentioned above we get, from the series of May 1934, the coast seaward, they appear where the big copepods end. We must, however, be cautious in drawing conclusions. It has been observed that several species of Mysidacea and also Pyrocypris are present in plankton only that has been fished during the night and disappear from the plankton at daylight. Evidently they retire to the bottom then. According to TATTERSALL from the above mentioned species only *Anchialina typica* is found in the daylight plankton, although it exhibits diurnal migrations too.

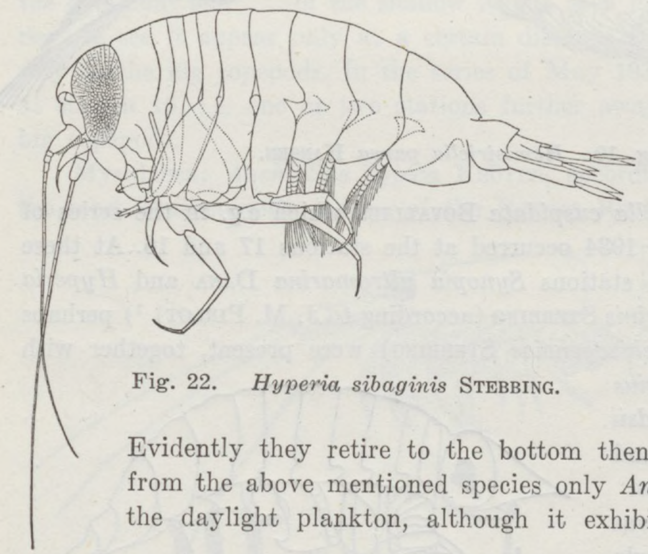

Fig. 22. *Hyperia sibaginis* STEBBING.

[1]) Kindly indentified by mr. J. P. HARDING, British Museum. MÜLLER, in "Die Ostracoden der Siboga Expedition" (1906) doesnot mention this species among the seven species distinguished by him. About his *P. acuminata*, however, he remarks: „Steht *P. natans* BRADY nahe, unterscheidet sich von ihr durch das an der vorderen Ecke stark abgerundete Rostrum." Mr. HARDING wrote me: "As you will see from my camera drawings or by looking at your own specimens some (like A) resemble *P. acuminata*, others (like B) are almost exactly the shape figured by BRADY as *P. natans* while others appear to be intermediate between the two. It looks as if the two species are identical but I am unwilling to make such a decision without seeing the types".

Hemisiriella parva is mentioned by him among the species that are found only very occasionnally and in single specimens by day. Now the station 15 was visited on May 21th 1934 in the evening at 9 o'clock and 16 on May 22th early in the morning at 2 o'clock.

A few words, finally, regarding some other constituents of the zooplankton which have been studied somewhat more in detail.

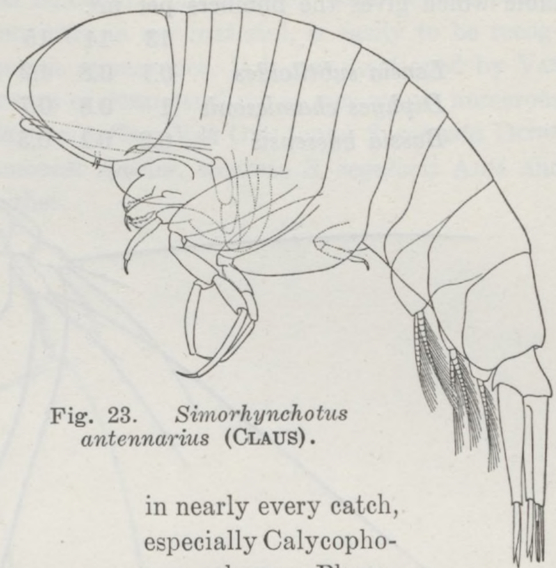

Fig. 23. *Simorhynchotus antennarius* (CLAUS).

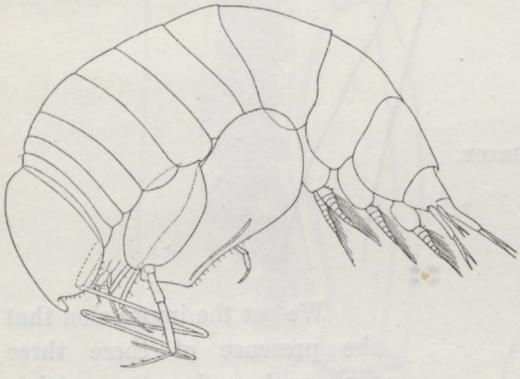

Fig. 24. *Parascelus edwardsii* CLAUS.

Siphonophores were present in nearly every catch, especially Calycophorae, whereas Physophorae were much rarer. The commonest Calycophorae are *Diphyes chamissonis* HUXLEY, *Lensia subtiloides* LENS and VAN RIEMSDIJK (these two were commonest also in the Barries Reef Lagoon), and *Bassia bassensis* QUOY and GAIMARD [1]).

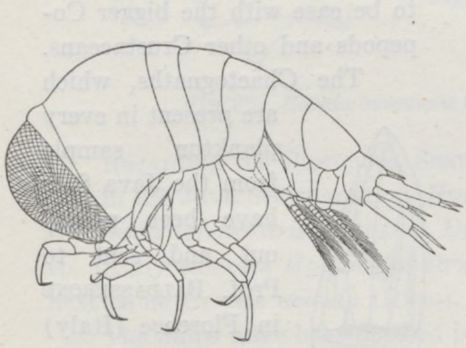

Fig. 25. *Hyperia dysschistus* STEBBING.

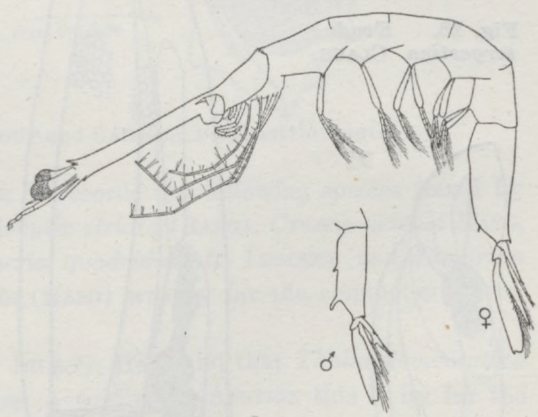

Fig. 26. *Lucifer intermedius* HANSEN.

[1]) All kindly identified by Mr. MONRO, British Museum. In LENS en VAN RIEMSDIJK's Siphonophora of the Siboga Expedition these three species are mentioned under the names *Diphyopsis weberi*, *Diphyes subtiloides* and *Abyla bassensis* resp.

Their distribution in the catches of May 1934 is shown by the following table which gives the numbers per m³.

	13	14	15	16	17	18	19	20
Lensia subtiloides	0.1	0.8	4.2	1.3	1.7	1.2	6.1	2.7
Diphyes chamissonis	1	0.8	0.7	0.3	—	1.7	1.6	5
Bassia bassensis	0.2	0.1	0.5	0.1	0.3	1.9	rr	—

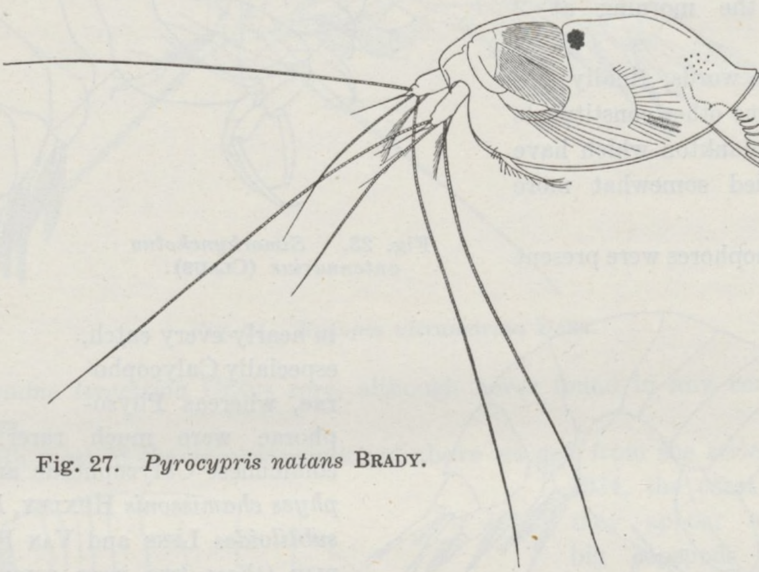

Fig. 27. *Pyrocypris natans* BRADY.

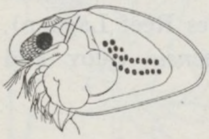

Fig. 28. *Evadne tergestina* CLAUS.

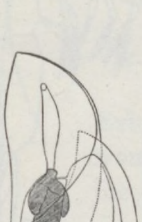

Fig 29. *Diphyes chamissonis* HUXLEY. *Eudoxid.*

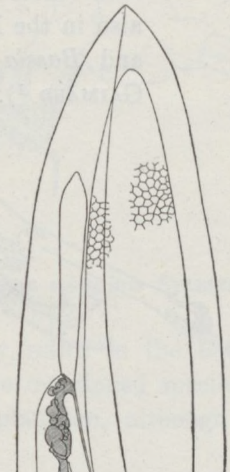

Fig. 30. *Diphyes chamissonis* HUXLEY.

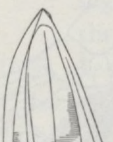

Fig. 31. *Lensia subtiloides* LENS and RIEMSDIJK.

We get the impression that the presence of these three Siphonophores is not so restricted to a definite zone as seems to be case with the bigger Copepods and other Crustaceans.

The Chaetognaths, which are present in every plankton sample from the Java Sea, have been picked out and sent to Prof. BALDASSERONE in Florence (Italy) but have not yet been received back. P. VAN OYE, in 1917, published a paper on the Chaetognatha of the Java

Sea [1]). The commonest species was the very transparent *Sagitta enflata* GRASS which in my catches too was often numerous. On the other hand *Sagitta planctonis* STEINHAUS, which was also not rare in my material, is easily to be recognized by its straight, stiff and opaque appearance. It is not mentioned by VAN OYE, who seems to have been unaware of STEINHAUS' paper, nor was it numerous in the Siboga material. Next to *Sagitta enflata* VAN OYE found *S. robusta* DONC. and *S. bedoti* BERANECK the commonest species, whereas *S. regularis* AIDA and *S. neglecta* AIDA were not rare either.

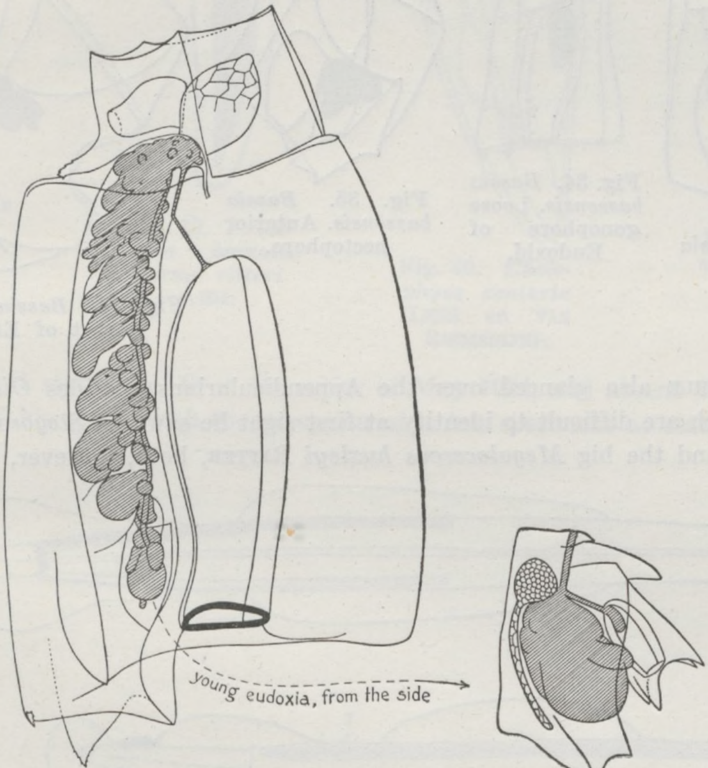

Fig. 32. *Bassia bassensis* QOUY and GAIMARD. Polygastric stage.

Regarding the Pteropoda SUNIER [2]) records the following species found by him in the Java Sea plankton: *Hyalocylix striata* (RANG), *Creseis acicula* RANG, *Cavolinia longirostris* LESUEUR, *Diacria quadridentata* LESUEUR and *Limacina* sp. In my samples *Hyalocylix striata* (RANG) was by far the commonest form, next came *Creseis acicula* (RANG).

The Salps have been studied by IHLE [3]). He found that *Thalia democratica* (FORSKÅL) was the commonest species. According to APSTEIN this is by far the

[1]) P. VAN OYE, 1918, Untersuchungen über die Chaetognathen des Javameeres. Contributions à la Faune des Indes Neerlandaises, Fasc. IV.
[2]) A. L. SUNIER, 1917, Voordracht over het Pelagiaal van de Javazee.
[3]) J. E. W. IHLE and M. E. IHLE-LANDENBERG, 1935, Über eine kleine Salpen Sammlung aus der Javasee. Zoöl. Anz. Bd. 110.

commonest warm water salp, which was confirmed for the Malay Archipelago by the catches of the Siboga expedition. Next came *Cyclosalpa floridana* APSTEIN. Rarer were *Salpa cylindrica* CUVIER, S. *fusiformis* CUVIER and *Brooksia rostrata* (TRAUSTEDT).

Fig. 33. *Bassia bassensis.* Eudoxid.

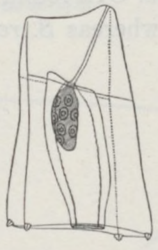

Fig. 34. *Bassia bassensis.* Loose gonophore of Eudoxid.

Fig. 35. *Bassia bassensis.* Anterior nectophore.

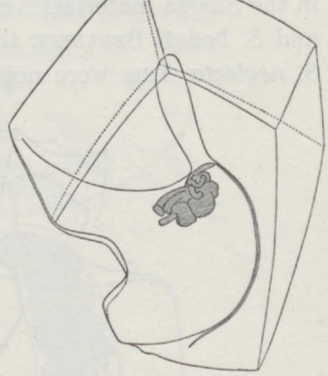

Fig. 36. *Bassia bassensis.* Bract of Eudoxid.

Prof. IHLE also glanced over the Appendicularians. Besides *Oikopleura*-species which are difficult to identify at first sight he saw a.o. *Stegosoma magnum* LGH. and the big *Megalocercus huxleyi* RITTER, both, however, in a few

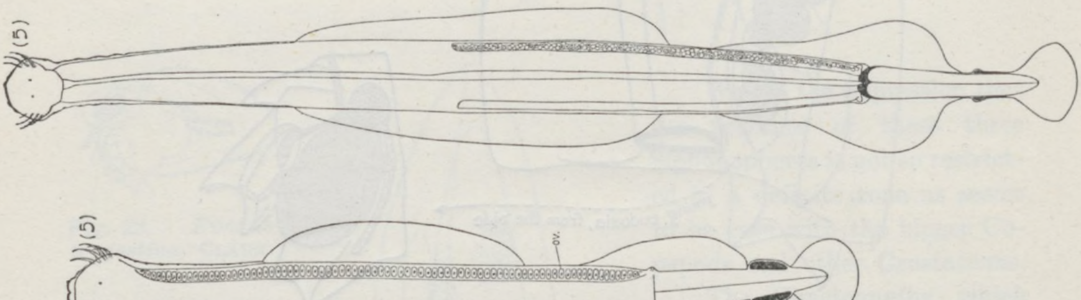

Fig. 37. *Sagitta pulchra* DONCASTER, *Sagitta enflata* GRASS., *Sagitta planctonis* STEINHAUS.

samples only. A *Fritillaria* species may sometimes be very numerous; it was identified by IHLE as *Fritillaria borealis* forma *ritteri* AIDA = *Fritillaria borealis*

truncata ritteri LOMAN, one of the seven species found by IHLE among the Siboga material and probably not the only one occurring in the Java Sea. It was

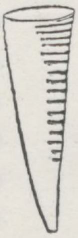

Fig. 38. *Hyalocyclix striata* (RANG).

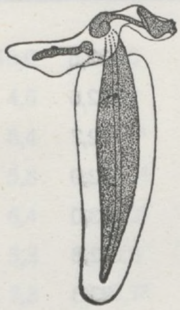

Fig. 39. *Fritillaria borealis* forma *ritteri* AIDA.

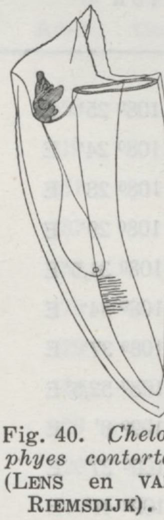

Fig. 40. *Chelophyes contorta* (LENS en VAN RIEMSDIJK).

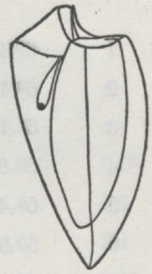

Fig. 41. *Muggiaea* spec. nov.

numerous at station nr. 18 of the series of May 1934, and absent at the other stations of his series, with the exception of a few specimens at stations nr. 17 and 20.

TABLE I

Java Sea April — October 1932.

Station	Position		Depth of the sea	Salinity Surface		Salinity Depth		P_2O_5 mg/m³ Surface		P_2O_5 mg/m³ bottom		Plankton volume cc per m³		Copepoda in 1 m³		Undinula vulg. in 1 m³	
				April	October	April	October	April	October	April	October	April	October	April	October	April	October
1	6° 18,4' S	108° 25' E	12,5 m	32,6	34,1		33,9	16,2	6,8	—	10,0	3,6	6,1	355	373	—	—
2	6° 16' S	108° 24' E	20 m	32,6	34,0		33,9	6,0	3,4	—	4,6	2,2	6,7	319	273	$2,9^3$	—
3	6° 13' S	108° 28' E	32,5 m	32,7	33,6		33,8	4,1	3,4	—	6,4	$1,6^4$	1,8	261	191	$0,2^8$	—
4	6° 9,4' S	108° 29' E	40 m	32,9	33,9		33,9	4,5	2,0	—	5,8	$0,9^6$	0,4	287	135	$5,0^3$	$0,9^4$
5	6° 4,6' S	108° 31,5' E	44,5 m	33,0	33,9		34,0	5,2	4,0	—	6,4	$0,3^4$	0,2	59	90	1,4	3,1
6	5° 59' S	108° 34' E	48 m	32,8	33,8		34,0	5,2	3,4	—	5,2	0,8	0,2	179	86	$3,0^5$	3,1
7	5° 38' S	108° 37' E	53 m	33,3	33,8		34,2	4,2	4,3	—	7,3	$0,7^7$	2,0	29	89	$1,2^1$	$0,3^7$
8	5° 38' S	108° 52,5' E	55 m	33,0	34,0		34,0	3,0	3,7	—	5,5	1,4	0,7	186	44	16,2	$1,7^2$
9	5° 28' S	109° 8' E	54 m	32,4	34,3		34,4	—	5,5	—	7,9	$0,7^8$	1,0	106	83	$7,0^5$	$0,4^8$
10	5° 10' S	109° 27' E	56 m	33,1	33,9		$34,2^5$	5,3	5,5	7,7	7,9	0,7	1,1	126	46	$6,4^4$	—
11	4° 54' S	109° 41' E	57 m	33,2	33,2	33,8	33,9	5,0	7,3	5,5	8,5	$1,0^6$	2,4[1])	142	67	$0,1^2$	$0,3^9$
12	4° 41' S	109° 55,2' E	59 m	33,4	33,1	34,0	33,7	4,7	7,9	5,2	7,9	$0,5^8$	2,2[1])	106	161	—	—
13	4° 26,6' S	110° 12,8' E	47 m	33,0	33,2		34,2	6,5	7,3	—	6,7	$0,5^3$	3,6[1])	104	92	—	—
14	4° 12' S	110° 25' E	48 m	32,6	33,1		34,0	6,2	7,9	—	7,9	0,4	1,0	120	227	0,3	$0,0^8$
15	4° 0' S	110° 37' E	40 m	32,4	33,9	33,2	34,0	6,7	6,1	6,7	10,4	$0,5^9$	1,6	142	174	$1,0^6$	$0,4^3$
16	3° 49' S	110° 52' E	35 m	31,6	33,6		34,1	4,5	6,7	—	10,4	1,9	0,9	143	264	$0,0^7$	$0,3^5$
17	3° 40' S	111° 15' E	37 m	31,3	33,4	33,1	34,4	7,2	6,1	11,0	7,9	0,9	1,6	180	158	2,7	$0,3^6$
18	3° 28,5' S	111° 24' E	27 m	29,9	32,5	32,7	$34,2^5$	7,7	5,5	11,7	11,0	1,3	$1,8^5$	238	264	$3,1^5$	$1,6^5$
19	3° 21,5' S	111° 29' E	22 m	28,2	31,8	$32,2^5$	33,7	6,5	4,3	9,7	9,2	$2,2^5$	3,4	379	237	0,9	1,1
20	3° 18' S	111° 38' E	14,5 m	26,9	31,9	31,7	33,6	6,5	5,2	11,0	9,2	2,9	5,6	838	526	—	—
21	3° 8' S	111° 40' E	$13,2^5$ m	27,5	31,2	31,5	33,5	—	5,2	—	10,4	5	7,8	1142	357	—	—
25	3° 41,5' S	112° E	20,5 m	30,4	33,0	31,6	33,8	6,7	6,1	9,7	7,3	1,1	2,3	617	210	$0,4^1$	$0,3^5$
26	4° S	112° E	31 m	30,9	33,3	32,6	34,4	5,6	5,2	9,8	8,5	$0,2^4$ [2])	2,2	50	107	—	$7,2^7$
27	4° 30' S	112° E	45 m	31,8	34,0	33,2	34,5	4,7	4,0	4,7	5,5	0,3 [2])	1,5	67	22	3,7	$3,2^6$
28	5° S	112° E	60 m	32,1	34,5	33,5	34,5	4,0	5,2	4,5	6,1	1,6	1,5	118	92	8,0	0,4
29	5° 30' S	112° E	67 m	32,7	33,6	$33,6^5$	34,3	4,7	4,3	6,8	7,3	0,9	1,3	175	82	8,1	0,6
30	5° 48' S	111° 37' E	67 m	33,6	33,5	33,8	34,1	4,2	6,7	6,7	10,0	0,4	0,9	129	162	$5,6^4$	$0,5^2$
31	5° 58' S	111° 22' E	57 m	33,6	33,4	$33,6^5$	34,1	3,5	6,7	6,7	9,0	$0,3^8$	0,8	149	108	$1,6^4$	$0,2^5$
32	6° 11' S	111° 5' E	58 m	32,5	33,3	33,8	33,9	2,5	8,0	7,2	10,0	0,3	0,9	135	243	—	$0,3^6$
33	6 23' S	110° 47' E	23 m	32,6	33,4	33,3	33,6	7,2	7,3	11,8	11,0	1,6	2,1	423	590	—	—

[1]) High volumes caused by presence of many salps, siphonophores etc.

[2]) Abnormally low volumes caused by bad condition of plankton.

TABLE II **Diatoms, April 1932.**

Symbols: [1]) rr = very rare; r = rare; + = present, neither rare nor common; c = common; cc = very common; ccc = abundant.

April 1932	Java											Borneo																	Java
Station	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	25	26	27	28	29	30	31	32	33
Bacteriastrum hyalinum et *varians*	r										rr					r				rr	+									r
Biddulphia sinensis	rr	rr				r									r	c	c	c	+	+	c	c	rr					rr		r
Cerataulina bergonii et *compacta*		rr	rr	rr	rr	r																						r		
Chaetoceras coarctatum	+	+						r		rr	r	c	r	c	+	r	c	+	r	+	c	r	rr	rr		rr			rr	r
„ *lorenzianum*	cc	c		r				r						rr	+	r	+		rr	+	+	+								+
„ *peruvianum*	+	+														rr	+													r
„ *pseudocurvisetum*		+															+			rr	r									rr
Coscinodiscus gigas	c	+	r	rr	rr	rr		rr		rr	r	r	r	+	c	rr	rr	rr	rr		rr	rr	rr	rr	rr	rr	rr	rr	rr	r
„ *jonesianus*	r	rr		r												cc	cc	c	c	c	c	cc	r				r	r	+	c
„ „ var. *tenuis* MEISTER [1])	+	r		rr																		rr								+
„ *nobilis*	r	r		rr		+										r	r	r		rr		r					rr			r
Guinardia flaccida	rr	rr													rr			rr		r	r									
Hemiaulus sinensis	rr	rr																												
Hemidiscus hardmanianus	rr	rr				r		rr		r	r	+	r		+	r	+		rr	rr		rr								r
Rhizosolenia alata	c	+		rr				r	rr						r	r	+	r	rr	r										+
„ *arafurensis*														r	r					r	r									
„ *calcaravis*	c	+		rr								rr			r		+				r									r
„ *clevei* [2])	cc	c	r	rr	rr		rr	+		rr		+	+	+	+	r	rr			r			rr							+
„ *clevei* [3])	rr							rr		rr	rr				r		rr	r		rr	rr								rr	r
„ *hebetata*	+	r								rr	c	r	r	r	rr	rr	rr												rr	+
„ *imbricata*	c	+												r	r	r	r			r		rr								+
„ *robusta*															rr	rr	rr	rr												rr
„ *styliformis* (atq. *latiss.*)	r	r								rr						r	+	+	r	rr	rr							rr		
„ „ var. *longispina*	c	+							rr	rr	cc	+	+	+	+	r	rr									rr				c
Stephanopyxis palmeriana																				r										rr
Streptotheca indica			rr					rr		r	r	r					rr							r					rr	rr
Thalassiothrix frauenfeldi et *nitzschioides*	r	r																		+	+	r								+
Trichodesmium								rr		r	cc	+	+	r	rr	rr	rr							rr	+	r	r	rr	rr	rr

[1]) According to ALLEN and CUPP. Plankton Diatoms of the Java Sea. Annales du Jardin Botanique de Buitenzorg, Vol. XLIV, 1935.
[2]) a variety of *Coscinodiscus jonesianus* which resembles the var. *tenuis* MEISTER (MEISTER, Kieselalgen aus Asien, 1932) but, as mr. ALLEN and miss CUPP write me, identification is not certain; possibly a new variety; [3]) diameter 107^5 rr; [4]) ?, diameter 170 rr!

TABLE III **Diatoms, October 1932.**

October 1932	Java																					Borneo									Java
Station	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	25	26	27	28	29	30	31	32	33	34
Bacteriastrum hyalinum et *varians*		rr								r			rr			rr	rr					r									
Biddulphia sinensis		c	r					rr								r	+	r				+	r						rr	+	r
Cerataulina bergonii et *compacta*.	rr	r	rr						r																				rr	cc	cc
Chaetoceras coarctatum	+	+														r	r	r	rr	r	r	r					rr	rr	r	+	
„ *lorenzianum*		+																				r							rr	c	+
„ *peruvianum*																														+	+
„ *pseudocurvisetum*		cc								r												r								+	+
Coscinodiscus gigas.	+	c	+	r	rr	rr	rr	r	r	r	r	r	r	r	r	+	+	r	rr	r	+	c	+	r	rr	rr	rr	rr	rr	+	r
„ *jonesianus*		+														rr	rr	rr	rr	rr	rr	r						rr	r	+	+
„ „ var. *tenuis* MEISTER .			rr								rr					r	rr													r	r
„ *nobilis*		cc	rr													rr	rr	rr	rr	rr	r	rr	rr								
Guinardia flaccida	rr	+	r													r														+	+
Hemiaulus sinensis		+	r																										rr	r	
Hemidiscus hardmanianus	r	+	r					rr			r	r		r	r	+	+	r		rr	r	c	r	rr				rr		rr	r
Rhizosolenia alata			r					rr		r	rr			rr		rr	r					r	rr				rr	rr			+
„ *arafurensis*														rr		rr	rr				rr	r								+	+
„ *calcaravis*.	rr		rr					rr									r					rr	r	r							r
„ *clevei*															rr	rr	r				rr	r	rr	r			rr	rr		rr	
„ *clevei*								+																							
„ *hebetata*			r																												
„ *imbricata*	rr															rr														+	r
„ *robusta*																		rr				rr								rr	
„ *styliformis* (atq. *latiss.*). . . .	rr	cc	+																			rr							r	c	c
„ „ var. *longispina* . .										r	r	r			r	r		r	r		rr	rr					rr		r	c	c
Stephanopyxis palmeriana		c	rr									r																			r
Streptotheca indica			r					rr	rr	+	c	+	+	r	r	r	r	r					r	r			rr	rr	rr	r	r
Thalassiothrix frauenfeldi et *nitzschioides* .	rr	r																												rr	
Trichodesmium			rr	r	+	r	r			+	+	r	rr												rr	r	r	r	rr		

TABLE IV

Java Sea May, 1934.

Nr.	May 1934	Position	Depth. meters	Salinity, surface	Salinity, bottom	Volume under 1 m²	Volume in 1 m³	Undinula vulgaris under 1 m²	Undinula vulgaris in 1 m³	id. juvenes (under 1 m²)	Labidocera acuta (under 1 m²)	Eucalanus subcrassus > 2 mm (under 1 m²)	Euchaeta concinna > 2 mm (under 1 m²)	Candacia bradyi > 2 mm (under 1 m²)	Copepods total > 2 mm (under 1 m²)	Copepods total > 2 mm in 1 m³	Temora discaudata	Centropages furcatus	Acartia pietschmanni a.c.sp.	Oithona (in 1 m³)	Calanopia minor (in 1 m³)	Calanopia elliptica (in 1 m³)	Calanus pauper (in 1 m³)	Tortanus gracilis (in 1 m³)	Tullbergella cuspidata (in 1 m³)	Synopia ultramarina (in 1 m³)	Hyperia sibaginis (in 1 m³)	Pseudeuphausia latifrons (in 1 m³)	Mysidacea (in 1 m³)	Lucifer intermedius (in 1 m³)	Pyrocypris natans (in 1 m³)	Remarks
1	3	5° 16′ S 106° 57′E	19	32,1	$32,7^5$	33	1,7	—	—	2	2	135	—	—	140	7,3																Diatoms fairly many.
2	3	5° 6′ S 106° 57′E	20	$32,2^5$	32,8	95	4,2	—	—	—	—	—	—	—	—	—	no further															Mostly echinopluteus, causing high volume.
3	4	3° 8′ S 107° E[1])	36	$32,3^5$	$32,8^5$	30	0,8	43	1,2	43	45	90	2	—	223	6,2				analyzed												Mixed zoo- and phytoplankton.
4	5	2° 43′ S 106° 56′E[1])	26	$32,3^5$	$32,9^5$	28,5	1,1	42	1,6	132	18	372	—	—	564	21,7																Eggs of *Clupea leiogaster* not rare.
13	21	3° 40′ S 109° 10′E	32	33,3	33,3	18	0,6	—	—	—	4,5	13,5	—	—	20	0,6	1,8	7,7	39	17	—	—	2,1	—	—	—	—	—	—	1,3	—	*Trichodesmium*, diatoms, salps, *Stolephorus* eggs common.
14	21	4° 12′ S 109° 3′E	41	$33,1^5$	33,5	24	0,6	—	—	—	—	4,5	r	—	45	0,1	1,1	7,7	11	50	—	—	6,6	1,1	—	—	—	—	—	0,3	22	Diatoms common, *Stolephorus* eggs fairly common.
15	21	4° 41′ S 108° 57′E	45	32,3	33,4	30	0,7	144	3,2	135	—	9	r	—	288	6,4	0,7	10	27	12	5,3	0,7	8	9,3	—	—	—	—	4	5	10	Many Radiolarians, less diatoms.
16	22	5° 12′ S 108° 49′E	45	32,4	33,5	37	0,8	246	5,5	18	12	168	12	12	468	10,4	11	21,7	20	13,3	28,3	1,7	8,3	3,3	1,1	2	1,3	6,7	0,7	2,8	2	Rich zooplankton, sagitta's, salps, *Hyalocylix* common.
17	22	5° 42′ S 108° 44′E	49	$32,4^5$	33,5	37	0,8	700	14,1	144	18	333	189	36	1404	28,6	5	11	4,8	32	14,6	—	1,2	—	1,6	0,6	0,6	0,2	0,4	3,0	0,6	As nr. 16, many fish larvae Clupeids, (*Fistularia* a.o.)
18	22	5° 57′ S 108° 23′E	45	$32,7^5$	31,6	42	0,9	37	0,8	2	37,5	2250	—	37,5	2362	52,5	80	15	10	35	10	—	—	—	—	—	—	0,1	—	2,7	—	Many *Fritillaria*, some *Stolephorus* a.o. fish eggs.
19	22	6° 5′ S 108° 20′E	33	32,6	$32,7^5$	86	2,6	112	3,4	194	2	544	—	—	825	25	140	3,4	5,7	—	—	—	—	—	—	—	—	—	—	—	—	Few diatoms and *Noctiluca*.
20	22	6° 13′ S 108° 18′E	10	33,3	33,6	19	1,9	22	2,2	—	4,5	18	—	—	63	6,3	25	2,2	27	6,7	—	—	—	—	—	—	—	—	—	—	—	Many *Noctiluca*, few diatoms.
21	23	5° 31′ S 107° E	48	32,2	31,9	30	0,6	292	6,1	27	45	90	—	—	454	9,5	no further															Some *Trichodesmium*.
22	23	5° 50′ S 107° 6′E	26	32,1	33,0	8,4	0,3	9	$0,3^5$	3	3	48	—	3	66	2,5				analyzed												Mostly zooplankton, little *Trichodesmium* and diatoms.

[1]) between Bangka en Billiton.

PRELIMINARY DIAGNOSES OF NEW BIRDS FROM NORTH SUMATRA II [1]

By

F. N. CHASEN

(Director, Raffles Museum, Singapore).

Piprisoma modestum sumatranum subsp. nov.

A dark race, like *P. m. finschi* of West Java, but with the white tips to the tail feathers larger, and as in the typical race.

Type. — Adult male, collected at Pendeng, Atjeh, North Sumatra, 500 metres (*c*), on 21st February, 1937. Mus. Buitenzorg, No. 10319.

Specimens examined. — One, the type.

Remarks. — This specimen appears to be the first example of the species recorded from Sumatra. RILEY (Bull. U.S. Nat. Mus. 172, 1938, p. 521) mentions Sumatra as in the range of *finschi*, but I have no knowledge of the material on which this remark is based.

Dendrocitta occipitalis sumatrensis subsp. nov.

Like *D. o. occipitalis* of South Sumatra, but paler on the lower breast and abdomen.

Type. — Adult male, collected at Simpang Agoesan, Atjeh, North Sumatra, 1000 metres (*c*), on 10th February, 1937. Mus. Buitenzorg, No. 10079.

Specimens examined. — Eight males and nine females from various places near the type locality compared with good series from Mt. Korinchi in South-West Sumatra.

Munia striata sumatrensis subsp. nov.

Like *M. striata subsquamicollis* of Tenasserim and the Malay Peninsula, but the pale rump band and under parts much more heavily speckled and squamated with grey. Birds from South Sumatra are *subsquamicollis*.

Type. — Adult male, collected at Blang Kedjeren, Atjeh, North Sumatra, 800 metres (*c*), on 16th April, 1937. Mus. Buitenzorg No. 11249.

Specimens examined. — Thirteen from North Sumatra compared with a larger series from the Malay Peninsula.

Remarks. — This is a very distinct race, recognizable at sight by its dark very heavily marked under parts.

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[1]) Cf. *ante*, p. 137.

Houppifer hoogerwerfi sp. nov.

Size and general characters as in the female of *H. inornatus,* but brown, not reddish chestnut in general colour, and entirely without trace of the broad buff streaks so characteristic of *inornatus*. General plumage, dull brown washed with rufous on the wings, and rather more yellowish on the under parts; almost everywhere finely but clearly vermiculated with black: throat, whitish; tail, metallic black.

Type. — Sexed by the collector as a female, but with a query added; obtained at Telaga Meloewak, Atjeh, North Sumatra, 1400 metres (*c*), on 24th April, 1937. Mus. Buitenzorg, No. 11744.

Remarks. — Although Mr. HOOGERWERF obtained only one specimen of this pheasant it differs so much from any female of *H. inornatus* known to me that I venture to describe it as new.

Euptilosus nieuwenhuisii inexspectatus subsp. nov.

Like *E. nieuwenhuisii* of Borneo, but the throat and the breast greyer and less green. Wing, 84 mm.

Type. — Adult male, collected at Lesten, Atjeh, North Sumatra, 700 metres (*c*), on 21st March, 1937.

Remarks. — This bulbul is one of the rarest of all birds. It has hitherto only been taken in Borneo and its discovery in Sumatra is one of Mr. HOOGERWERF's most noteworthy results.

Stachyris leucotis sumatrensis subsp. nov.

Crown darker and grey than in either typical *leucotis* of the Malay Peninsula, or *goodsoni* of Borneo: lores whitish as in the former; pale markings on the wings rufous as in the latter race.

Type. — Adult female, collected between Lesten and Pendeng, Atjeh, North Sumatra, 500 - 800 metres (*c*), on 16th March, 1937.

Remarks. — This species has not hitherto been recorded from Sumatra. Although only two specimens were obtained, the type differs so markedly from good series of both the allied forms that a new name is obviously required. The second specimen is immature.

Plaat III

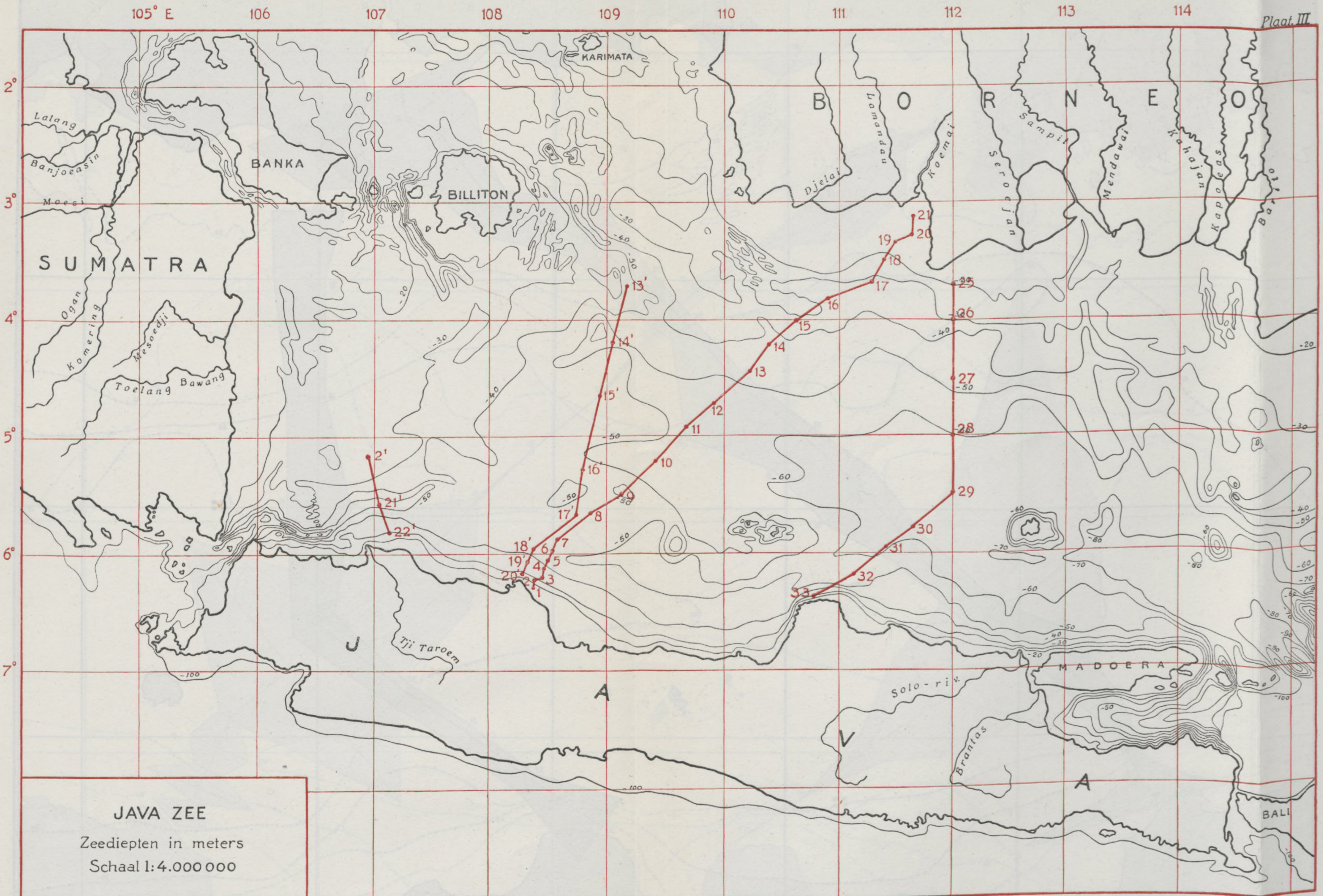


Chart 1. Java Sea with the numbers of the stations. Those with an ' are from May 1934. Depth in meters. Chart reprinted from J. H. F. UMBGROVE: "De Koraalriffen der Duizendeilanden (Java-zee)". Wetenschappelijke Mededeelingen van den Dienst van den Mijnbouw in Nederlandsch Indië No. 12, 1929.

S = abundance of salps * very poor plankton in bad condition

Chart 2. Planktonvolume per m³. To the left the planktonvolumes in April 1932, to the right those in October 1932. Depth of the sea in m. 1 cm = 1 cc pro m³. × ½.

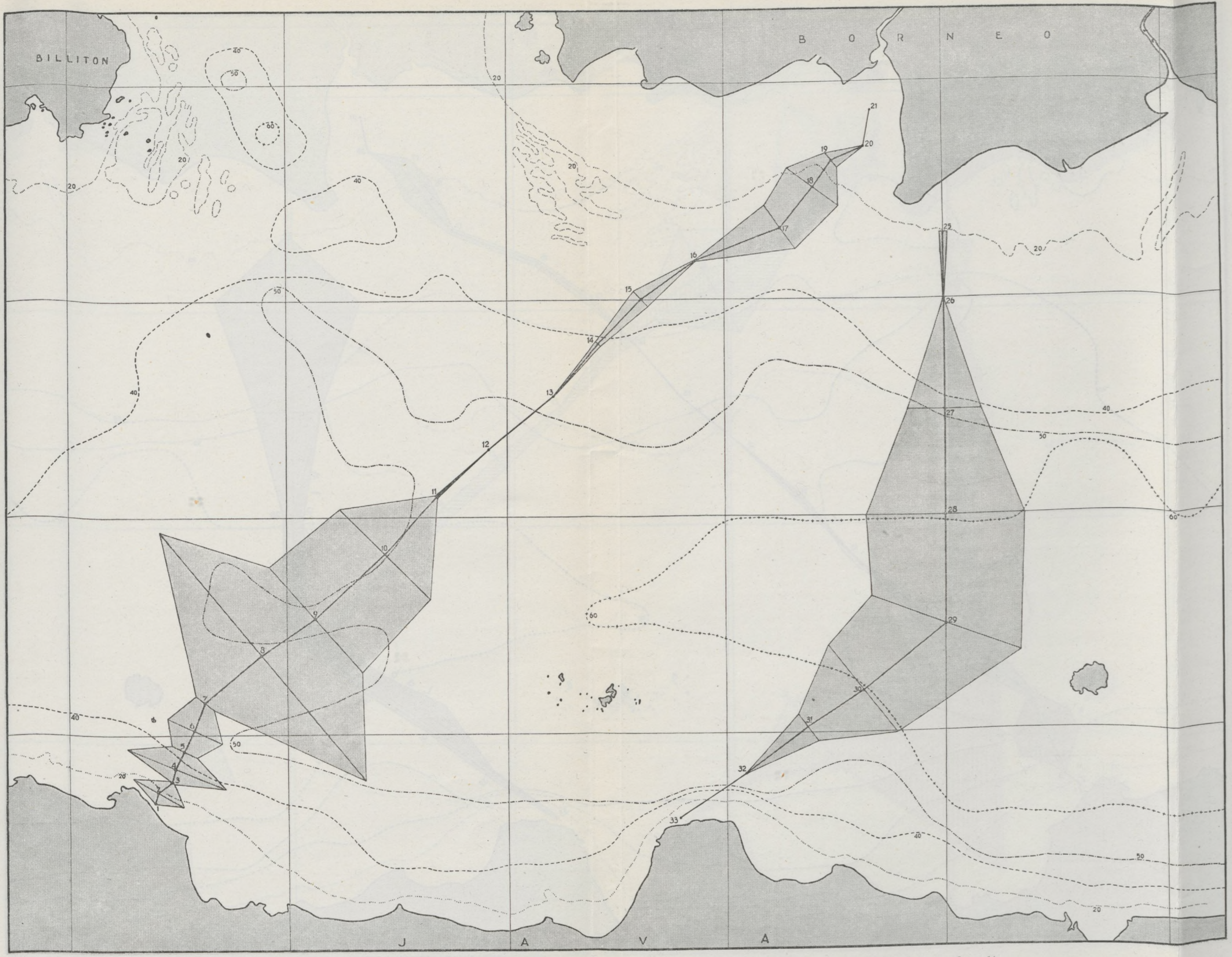


Chart 3. Distribution of *Undinula vulgaris*. April 1932. 1 cm (left and right) = 1 individual pro m³. × ½.

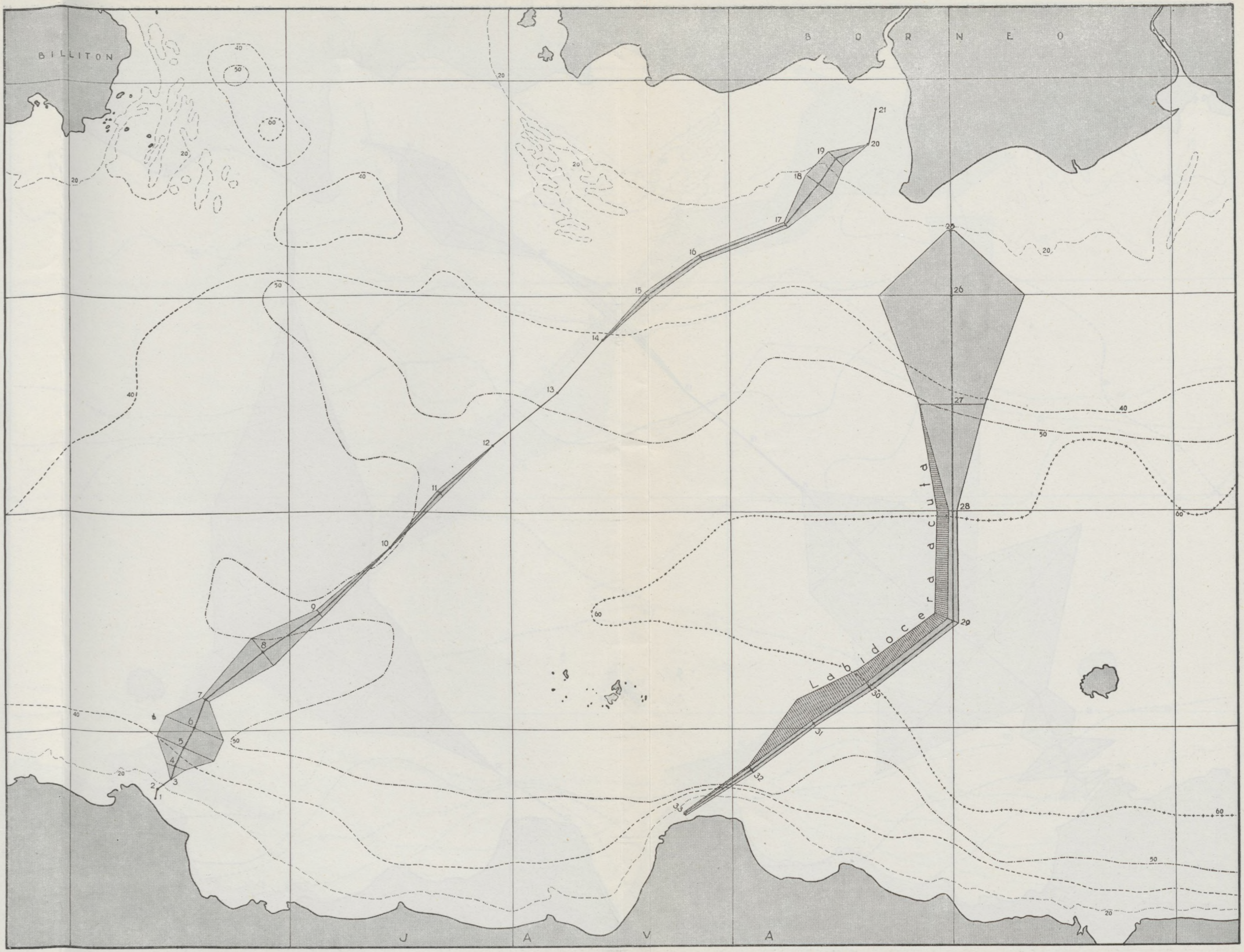


Chart 4. Distribution of *Undinula vulgaris*. October 1932. 1 cm = 1 individual pro m³. × ½.

Chart 5. Distribution of *Eucalanus, Euchaeta* and *Candacia*. April 1932. 1 mm = 10 individuals under 1 m². × ½.

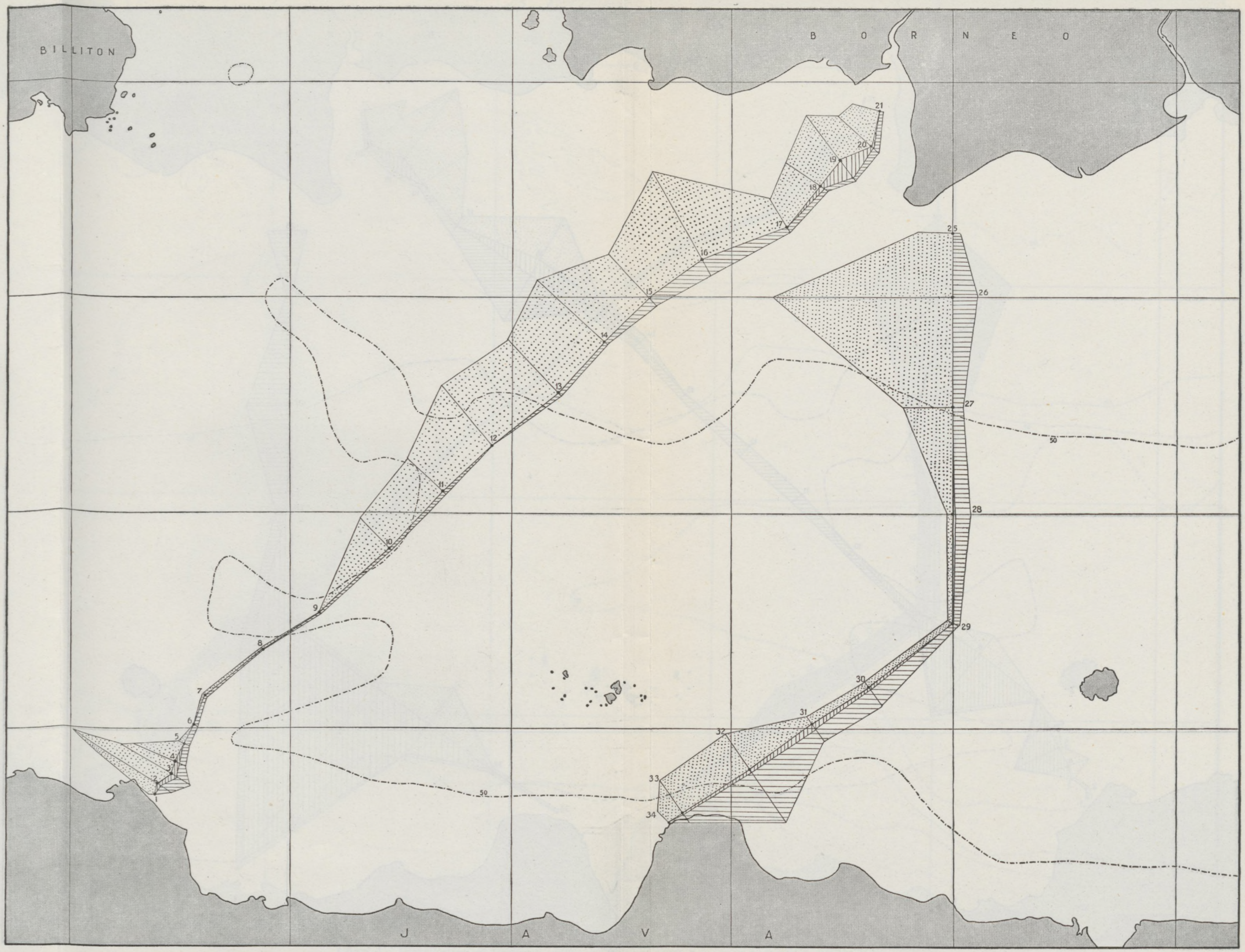
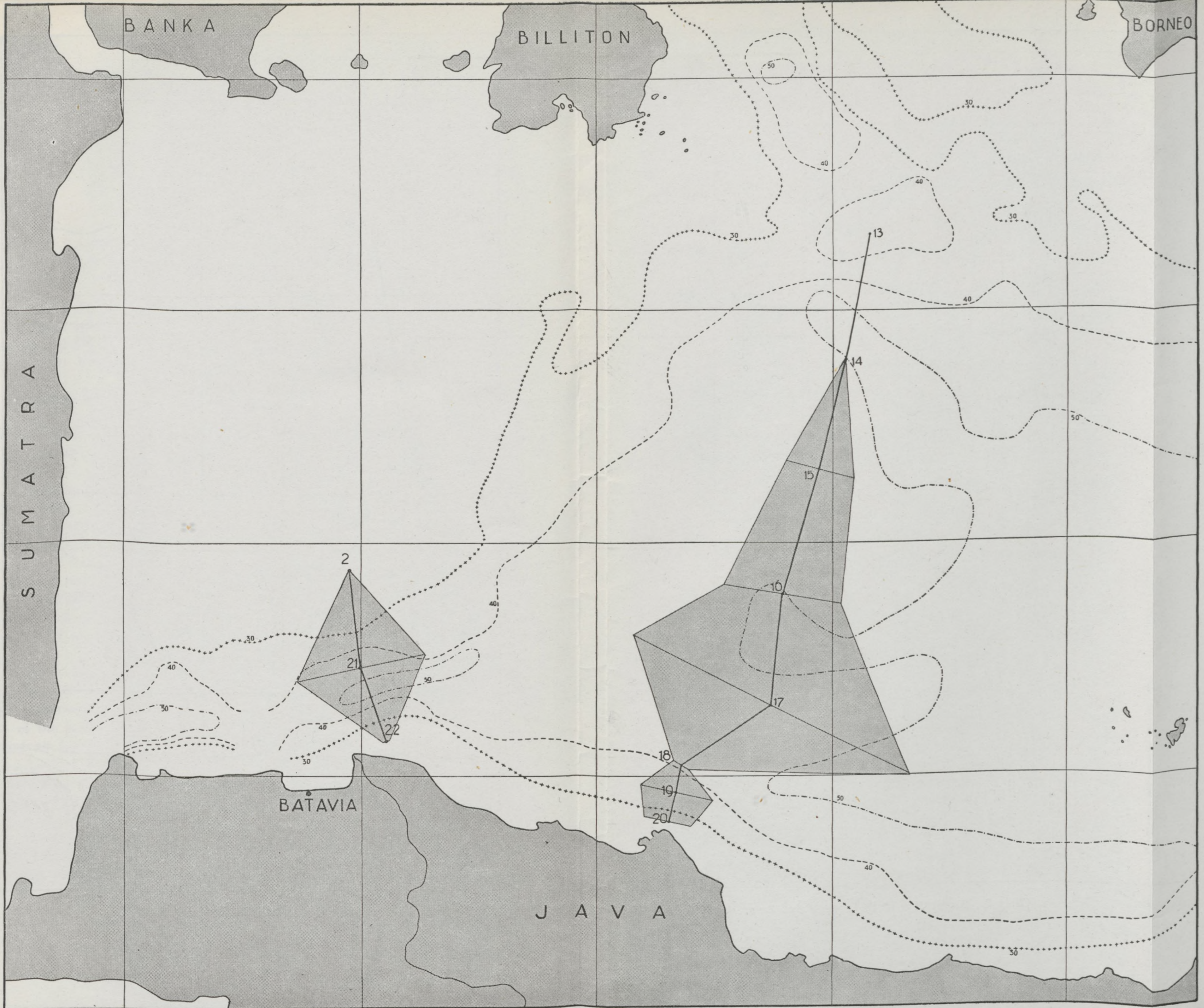


Chart 6. Distribution of *Eucalanus*, *Euchaeta* and *Candacia*. October 1932. 1 mm = 10 individuals under 1 m². × ½.



BANKA
BILLITON
BORNEO
SUMATRA
JAVA
BATAVIA
13
14
15
16
17
18
19
20
2
21
22
30
40
50

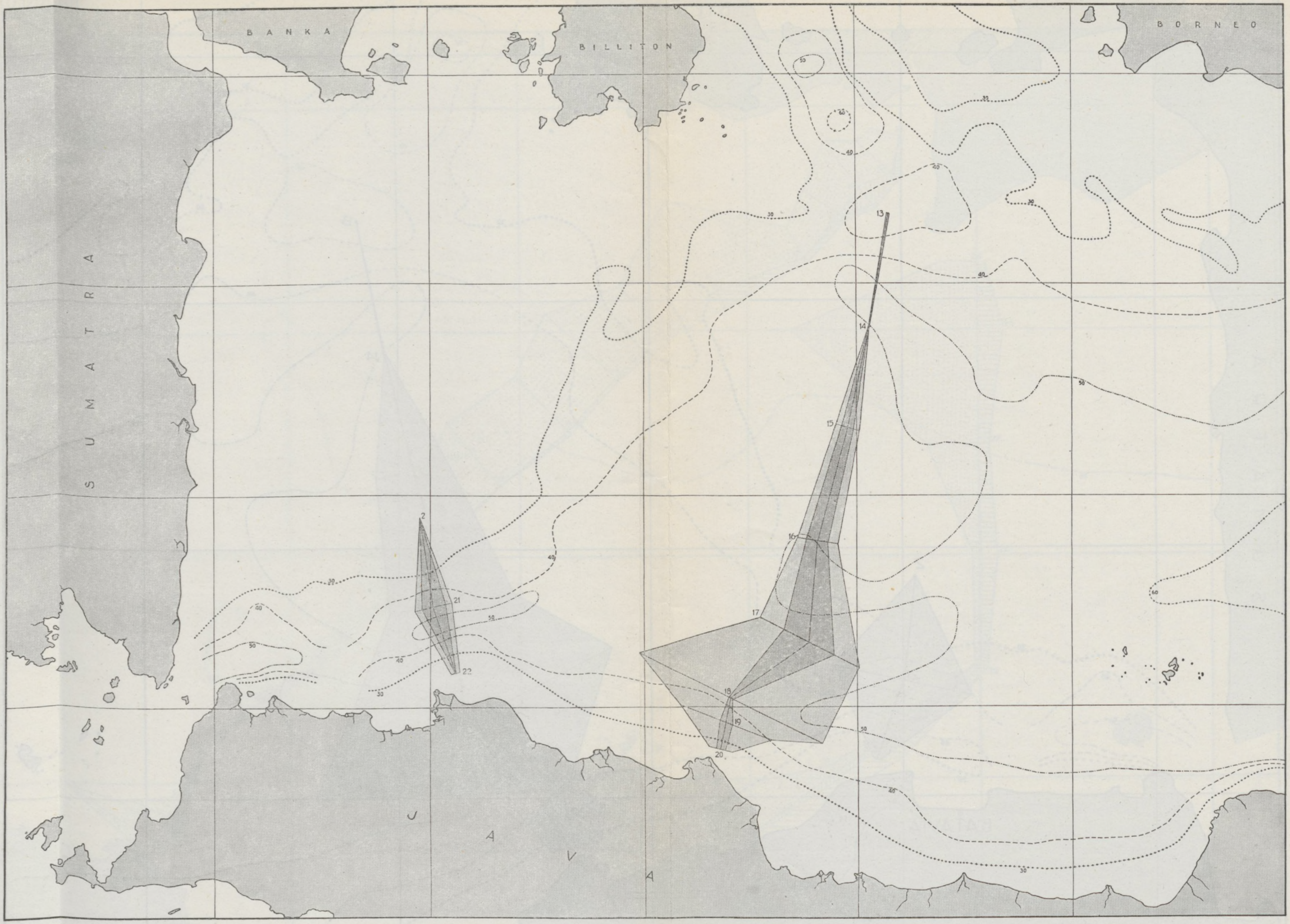


Chart 8. Distribution of the Copepods of 2 mm or more, 1934, May (darker *Undinula vulgaris*). 1 mm (left and right) = 1 individual pro m³. × ½.

FOUR NEW MAMMALS FROM JAVA.

By

F. N. CHASEN

(Director, Raffles Museum, Singapore).

A small collection of Javan mammals sent to me for examination by Dr. MAX BARTELS contains some very striking novelties. It also adds two genera (*Otomops* and *Glischropus*) to the known mammal fauna of Java, and I am grateful to Dr. BARTELS for the privilege of studying such interesting material.

Petinomys bartelsi sp. nov.

A small species with very flattened bullae, nearest to *P. vordermanni* (Billiton), and *P. phipsoni* (Tenasserim), but much larger than either, and with the whiskers and aural tufts strongly developed as in *P. genibarbis.*

Cotypes. — (a). Subadult male, skin and skull, collected at Tjilondong, Mt. Pangrango, West Java, about 900 metres, on 19th April, 1938. BARTELS' Coll. No. 2000.

(b). A second specimen is the skin of an adult female, without skull, taken on 2nd September 1902, also on Mt. Pangrango, about 1000 metres. BARTELS' Coll.

External measurements. — Head and body, 133 (145); tail, 119 (130); hind-foot (s.u.) 28 (28); ear, not perfect —, (17) mm. The first measurements given are those of the male taken in the flesh; the figures in brackets are a rough estimation of the measurements of the female made by me from the dried, flat skin.

Skull. — Total length, 34.5 (27); condylo-basilar length, 29.8; zyomatic width, 20.5 (17); interorbital width, 7.5; diastema, 7.5 (5.5); palatilar length, 14.6; upper molar row, 6.5 (5.5); length of nasals, 9.4 (7) mm. Although the teeth of the male cotype are scarcely worn, and the skull is obviously not that of an aged animal, it has probably reached its maximum size. The measurements in brackets are those of the type of *P. vordermanni,* taken from JENTINK. The only specimens available for comparison are from the Riouw Archipelago; they are, therefore, not strictly topotypical. Comparing the skulls of *bartelsi* and *vordermanni* we find that the former has relatively longer nasals and, although there is so much difference in size between the skulls, actually smaller bullae. The molars of *bartelsi* are also rather simpler in character and their external accessory cusps are hard to discern. The incisors are very pale yellow.

Colour. — Except that the tail is markedly bi-coloured at the base the colour probably does not differ from that of *P. vordermanni,* for the only differences I can see between the adult cotype and several specimens of *"vordermanni"* from the Riouw Archipelago could well be due to slight individual variation. Top of the head and the back, fulvous, but with the broadly dull black base of the fur showing through everywhere except on the crown: parachute, almost entirely black, although the extreme edge seems to have been white. Hands, brownish buff; feet, much darker and near blackish brown. Tail, brown, parti-coloured at the base in the manner of most small flying squirrels, the pale portion creamy-buff; under side of tail, pale cinnamon-rufous paling to creamy buff at the base. Under parts, now creamy white, but probably once quite white. Cheeks, orange-buff. A continuous black line runs over the point of the muzzle and encircles each eye. Whiskers etc., black, or nearly so.

The young male is quite different and is in an immature pelage differing rather widely in colour from that of the adult. This immature pelage I have not observed in *P. vordermanni* in which species even very young juveniles are much like adults in appearance. General appearance of the upper parts, dull black, the hairs finely tipped with drabby brown, producing little more than a heavily grizzled effect, the colour being most solid on the crown and middle of the back. Hands and feet, blackish brown. Under parts of body, white; cheeks tinged with orange-buff; sides of the neck greyish. Parachute black, above and below, tinged with brownish buff below; the extreme edge, white. Tail, dull black, paling to dirty white tinged with brown-buff at the base.

Remarks. — No squirrel of this group has hitherto been recorded from Java. In view of the great difference in size, the remarkable development of the whiskers, and the characteristic features of the skull noted above, I can as yet find no justification for regarding *bartelsi* as the local representative of the *vordermanni* group. The black whiskers of the adult cotype are plentiful and measure about 30 mm in length. There is also a very conspicuous broad pencil of softer hairs, about 21 mm long, on the cheek at the anterior base of the ear, and another, rather shorter tuft, originating near the posterior base of the ear. Tail, distichous, but not conspicuously so when seen from above.

P. bartelsi needs no detailed comparison with the very much larger *P. genibarbis* of Java. It is probably exclusively a forest-living species. One specimen was caught when a big tree (*Altingia excelsa*) was felled, and the other taken during the making of a forest clearing.

Otomops formosus sp. nov.

A large bat of the *Nyctinomus* association with skull characters (m^3 complete, premaxillae united, basi-occipital pits well defined, a prominent vertical projection on the zygoma) falling into the genus *Otomops* (THOS., 1913) which has hitherto not been recognized from any part of Malaysia. Not closely allied to any other Malaysian species, but with the external facies of *Chaerephon* rather than *Mops*. Apparently most closely allied to *O. wroughtoni* THOS.

(Journ. Bombay Nat. Hist. Soc. XXII, 1913, p. 87) of South India, and showing all the general characters of that form, but the forearm shorter (59.7 against 68 mm), and the skull slightly smaller.

Type. — Adult male, skin and skull, collected at Tjibadak, West Java, 400 (*c.*) metres, on 9th April, 1938. BARTELS' Coll. No. 1998.

External measurements (in the flesh, *fide* M. BARTELS). — Head and body, 86; tail, 43; ear from base of outer border, 30; forearm, 59.7 mm. In the skin the lower leg and hind-foot (c.u.), measure about 29 mm.

Skull. — Greatest length, 24; condyle to front of canine, 21; zygomatic breadth, 12.8; breadth of braincase, 10.9; front of canine to back of m^3 8.5 mm.

Colour etc. — Upper parts, deep blackish brown, the crown much paler and nearer greyish buff; a broad, well defined, grey collar across the hind neck; upper back adjacent to the collar, grizzled with whitish. Under parts, paler brown, the throat and forearm, drabby whitish grey continuous with the nuchal collar. Fur, short and like velvet; the ears, forearms and membranes furred as in *wroughtoni.* Anterior edge of the ear finely pectinated with small horny points.

Remarks. — The type and another very similar male (which I have not seen) were taken from a hole, probably an old nesting hole of a barbet, or woodpecker, in the decayed branch of a rubber tree. Dr. BARTELS informs me that in life the now broad grey collar was apparent only as a very narrow band.

Glischropus javanus sp. nov.

General appearance as in *G. tylopus* of the Malay Peninsula, Sumatra and Borneo (typ. loc.), but the forearm and lower leg longer; the skull shorter, slightly narrower, and much less flattened, the braincase being conspicuously more inflated and the profile of the skull therefore very noticeably less straight; the small anterior, upper premolar even more displaced internally, and the corresponding lower tooth smaller than in *tylopus.* Fur of the underparts less frosted owing to smaller pale tips to the hairs. Tragus, broader. No basal pits.

Type. — Adult male, skin and skull, collected at Tjiparaj on the south-west slopes of Mt. Pangrango, West Java, about 900 - 1000 metres, on 28th December, 1934. BARTELS' Coll. No. 1185.

External measurements (in the flesh, *fide* M. BARTELS). — Head and body 40 (39); tail, 40 (36); forearm, 32.7 (29.5); width of tragus at widest part, about 2 (1 *c.*); lower leg, foot and claw, 21.5 (19.5) mm.

Skull. — Total length, 12.6 (13.3); condyle to front of canine, 11.5 (12.2); mastoid width, 7 (7.3); zygomatic width, 8 *c.* (8.7); breadth of braincase, 6.5 (7); height of braincase, including bullae, 5.9 (5.5); back of m^3 to front of *c*, 4.7 (4.7) mm. The measurements given in brackets are those of an average adult of *G. tylopus.*

Remarks. — The genus *Glischropus* has not hitherto been recorded from Java. *G. javanus* may be the geographical representative (subspecies) of *G.*

tylopus, but when the two forms are compared the skulls look so different that in the present imperfect state of our knowledge I do not use a trinominal.

G. batjanus MATSCHIE from Batjan Island is a slightly differentiated form of *tylopus* distinguished by smaller average size (forearms of adults *fide* MATSCHIE, 28.4 - 29 mm).

The type of *javanus* was taken from the hollow top of a broken off and partially dead bamboo stem in cultivated country, but not far from the mountain forest.

Rhinolophus importunus sp. nov.

Like *R. javanicus* from the south coast of Central Java, but larger.

Type. — Adult female, skin and skull, collected at Tjiawitali near Wijnkoopsbaai on the south coast of West Java, on 23rd May, 1935. BARTELS' Coll. No. 1574.

External measurements. — Head and body, 50; tail, 26.5; ear, from base of outer border, 20, from base of inner border, 18.5, from crown, 16; forearm, 45.4 mm (from the flesh *fide* M. BARTELS). Forearms of a series, 44.2 - 46.7 mm.

Skull. — Total length, 19.8; length to front of canine, 19; mastoid width, 9.2; width of braincase, 8; zygomatic width, 9.6; nasal swellings, 5.4; $c.-m^3$, 7.2.

Remarks. — In 1909 some bats collected at Pangandaran, Dirk de Vries Bay on the south coast of Java were identified by THOMAS and WROUGHTON as *Rhinolophus borneensis* (Proc. Zool. Soc. Lond., p. 376). The same animals were afterwards separated as *R. javanicus* by ANDERSEN (Ann. Mag. Nat. Hist. (9), II, 1918, p. 375). In addition to the characters given by ANDERSEN (lancet, peculiarly shortened; nasal swellings, smaller; tooth-row, shorter) *javanicus* is characterised by its peculiar grey-brown colour.

R. importunus is very like *javanicus* in external characters. In colour the two forms are much alike, but the broad pale chevron on the mantle is obsolete or absent in *importunus* which also has the underparts very slightly darker, more uniform, and rather more heavily frosted than in *javanicus*. *R. importunus*, however, is larger in all its dimensions (forearms of *javanicus*, 40 - 43; skull to canine about 18.2 mm). From topotypical *borneensis* it differs in colour, larger body size, and shortened lancet. The skull is like that of full-sized adults of *borneensis* down to the smallest details. Although they are so obviously very closely related, contrary to my usual custom, I am reluctant to unite any of the Bornean and Javan bats of this group in a trinominal nomenclature. It seems that they replace each other geographically, in Java decreasing in size from west to east, but actually we know very little about them, and it may well be that *importunus* will be found in other parts of Java. According to Dr. BARTELS it occurs in its type locality in great numbers in an old mining shaft together with other leaf-nosed bats. The measurements and colour of a good series show little variation and the form cannot be placed with *javanicus* of which exact topotypes are available for comparison.

ON A COLLECTION OF FRESHWATER FISHES OF THE ISLAND OF BILLITON.

By

L. F. DE BEAUFORT

(Zoological Museum, Amsterdam).

In 1936 and 1937 Mr. F. J. KUIPER, to whom I wish to express my thanks here, presented the Zoological Museum of Amsterdam with several collections of freshwater fishes, made in different streams on the island of Billiton.

The only one, who has reported on fishes from that island is BLEEKER. In 1851 (2) he mentioned 10 marine species, in a paper issued the following year (3) he described 15 freshwater species, collected by Mr. C. DE GROOT. In 1857 (4) he recorded 43 marine and freshwater species and this number increased to 137 in a fourth paper (5). Two later papers in 1858 (6) and 1859 (7) did not add much to our knowledge of the ichthyology of Billiton.

The collections of Mr. KUIPER consist of 41 species. All species recorded by BLEEKER are present, with the exception of the following six: *Glyptosternum platypogon* BLKR., *Leiocassis poecilopterus* (C.V.), *Leiocassis micropogon* (BLKR.), *Ophiocephalus marulioides* BLKR., *Betta picta* (C.V.) and *Mastacembelus maculatus* C.V.

On the other hand, Mr. KUIPER collected the following 22 species, not yet known from Billiton: *Chaca chaca* (H.B.), *Clarias leiacanthus* BLKR., *Cryptopterus macrocephalus* (BLKR.), *Aoria nemurus* (C.V.), *Nemachilus kuiperi* n. sp., *Rasbora lateristriata* (BLKR.), *Rasbora pauciperforata* M. WEB. & DE BFRT., *Rasbora dorsiocellata* DUNCKER, *Cyclocheilichthys apogon* (C.V.), *Puntius fasciatus* (BLKR.), *Osteochilus vittatus* (C.V.), *Osteochilus spilurus* (BLKR.), *Fluta alba* (ZIEUW), *Ophiocephalus melanosoma* BLKR., *Ophiocephalus striatus* BL., *Ophiocephalus bankanensis* BLKR., *Ophiocephalus lucius* C.V., *Polyacanthus hasselti* C.V., *Sphaerichthys osphromenoides* CAN., *Trichopodus trichopterus* (PALL.), *Tetrodon (Crayracion) palembangensis* BLKR., and *Mastacembelus billitonensis* n. sp.

I. Systematic Part.

1. *Megalops cyprinoides* BROUSS.
   One specimen 400 mm long.
2. *Chaca chaca* (H.B.).
   One specimen, 210 mm long.

3. *Clarias leiacanthus* BLKR.

Three specimens, 190 - 320 mm.

4. *Clarias nieuhofi* C.V.

Five specimens, 233 - 630 mm.

5. *Clarias* (*batrachus* BL. ?).

One young specimen, 60 mm long, possibly belongs to this species.

6. *Clarias* (*teysmanni* BLKR. ?).

Ten specimens, 52 - 102 mm, probably belong to this species.

6a. *Clarias* spec. juv.

Seven specimens, 38 mm long, are too small to identify.

7. *Silurichthys phaiosoma* (BLKR.).

Thirteen specimens. Length 89 - 118 mm.

8. *Cryptopterus macrocephalus* (BLKR.).

Two specimens, 86 mm, differ from typical ones in having shorter maxillary barbels, which reach to anterior rays of anal. Colour brownish, with indications of darker longitudinal bands.

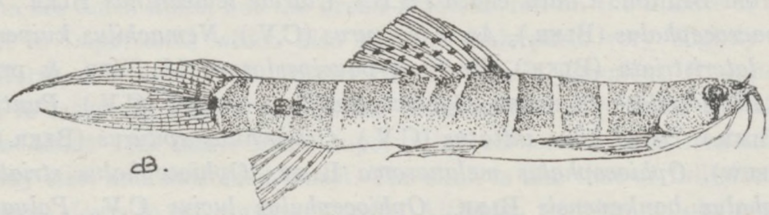
9. *Aoria nemurus* (C.V.).

Five specimens, 96 - 260 mm.

10. **Nemachilus kuiperi** n. sp. (Fig. 1).

D.l.8-9. A.i.5. P.9-10. V.i.7. Ll. circa 110. Ltr. $\dfrac{15}{\dfrac{1}{15}}$.

Height 5 - 6 in length, 6.5 - 8.4 in length with caudal. Head 4 - 4.6, 5.1 - 5.9 in length with caudal. Eye 4 - 4.9, with a free orbital margin, slightly more than interorbital space and 1.3 - 2.2 in snout. Nostrils close together, the posterior one an oval opening, the anterior one a tube. Mouth inferior, horseshoe-shaped. Lips swollen and somewhat papillate. Three pair of barbels, one at corner of mouth, reaching on operculum, but not to gillopening, one pair



Nemachilus kuiperi, **n. sp. (× $1\,{}^{2}/_{5}$).**

of maxillary barbels reaching to hindborder of eye and one rostral pair, which is somewhat shorter than the maxillary one. Dorsal truncate, the first divided ray longest and equal to head; its origin about midway between snout and upper caudal rays, somewhat in advance of ventrals, which reach to anus. Anal truncate, the first divided ray longest, shorter than head. First divided ray of pectorals longest, as long as or somewhat shorter than head. Caudal very deeply forked, the lobes pointed, the upper lobe longer than the lower one. Scales cycloid, slightly larger posteriorly. Head naked above, opercular region

scaly. Body completely covered with scales. Lateral line complete. Immediately above and below the lateral line on the caudal peduncle a longitudinal row of 3 - 6 much thicker, elongate and pointed scales, pigmented with dark along their border and generally with a shining pearly white knob in their centre. In some specimens a few other scales, also immediately above and below the lateral line show a similar pearly knob. Colour of preserved specimens brown above, whitish below, and with 12 light, narrow, crossbars on the back, more or less bordered with dark brown. There is also a faint bar on top of head, connecting the hindborders of the eyes, and a light spot above the opercle. The bars on the back are not symmetrical, often being more developed on one side than on the other. A dark brown band immediately behind the last light bar at base of caudal, forming a still darker patch where it crosses the lateral line. A small dark spot above axil of pectoral. A dark brown band from eye downwards. Dorsal with a deep black patch at base between first and second ray and with three longitudinal rows of black spots. Anal hyaline or with two longitudinal rows of very faint spots. Base of caudal with two transverse rows of dark spots. Pectorals and ventrals hyaline.

Twenty-two specimens, 45 - 69 mm.

This handsome fish, which I dedicate to its collector, resembles in its coloring *N. sayoma* H.B. and still more the fish described and figured under that name by DAY (8, p. 619 and Pl. CLV, fig. 8), which according to HORA (13, p. 57) represents another species, which he called *N. dayi*. *N. kuiperi* differs however by its much more forked caudal, by the belly being scaly, by the dark markings below eye and on base of dorsal, and specially by the peculiar patches of pearly scales on the caudal peduncle. As fas as I know, similar patches have never been described in species of *Nemachilus*. It seems improbable, that they represent secundary sexual characters, as they occur in all the 22 specimens examined, and it is hardly believable that these are all of the same sex. Moreover the secundary sexual characters which have been described in species of *Nemachilus* (HORA, 12; VLADYKOW, 16) are of a quite different nature.

N. kuiperi shows also some resemblance to *N. longipectoralis* POPTA, specially in the long pectoral and the deeply forked caudal, but the coloration is quite different and Miss POPTA would certainly have mentioned the patches of pearly scales if they had been present in her specimens.

11. *Rasbora cephalotaenia* (BLKR.).
    Eight specimens, 60 - 83 mm.
12. *Rasbora einthoveni* (BLKR.).
    Fifty-five specimens, 30 - 65 mm.
    In small specimens, 30 - 33 mm long, the lateral line is still incompletely developed.
13. *Rasbora lateristriata* (BLKR.).
    Twenty-eight specimens, 32 - 67 mm.

14. *Rasbora pauciperforata* M. WEB. & DE BFRT.
Fifty-five specimens, 31 - 54 mm.
In some specimens there is a very pronounced dark band from head to caudal. In others this band is very faint, and sometimes there are traces of red in the light band above it.
15. *Rasbora dorsiocellata* DUNCKER.
Thirty-one specimens, 19 - 55 mm.
Small specimens are much more elongate than larger ones. Possibly this is a sexual difference.
15a. *Rasbora* spec. juv.
Three specimens, 29 - 33 mm.
16. *Cyclocheilichthys apogon* (C.V.).
Two specimens, 62 and 155 mm.
17. *Puntius binotatus* (C.V.).
Seventy-one specimens, 41 - 159 mm.
18. *Puntius lateristriga* (C.V.).
Two specimens, 58 and 115 mm.
19. *Puntius fasciatus* (BLKR.).
Seven specimens, 60 - 69 mm.
20. *Osteochilus vittatus* (C.V.).
Twelve specimens, 80 - 187 mm.
All specimens, the large ones as well as the small ones, have only one large pore on the snout. The longitudinal dark lateral band is very conspicuous, and is continued on the head as well as on the caudal.
21. *Osteochilus spilurus* (BLKR.).
Seven specimens, 31 - 85 mm.
22. *Fluta alba* (ZIEUW).
Two specimens, 600 and 800 mm.
23. *Hemirhamphodon phaiosoma* BLKR.
Two males, 76 and 80 mm, and two females, 68 and 69 mm.
Colour of preserved specimens yellowish. The males with two narrow crimson lines, running parallel to each other along sides of body and tail; the females with a faint pinkish lateral band, bordered above and below with dusky.
24. *Hemirhamphodon pogonognathus* BLKR.
One male, 78 mm and seven females, 53 - 70 mm.
25. *Ophiocephalus melanosoma* BLKR.
One specimen, 335 mm.
26. *Ophiocephalus striatus* BL.
Ten specimens, 90 - 290 mm.
27. *Ophiocephalus gachua* H.B.
Five specimens, 65 - 135 mm.
28. *Ophiocephalus bankanensis* BLKR.
Four specimens, 63 - 240 mm.

Reddish violet above, creamy below. A row of blotches, each consisting of a group of black spots, along the middle of the sides of the body. A similar blotch on opercle. A band, also consisting of black spots, from hindborder of eye obliquely downwards, ending on lower part of opercle. Upper part of head with scattered black spots. Similar but smaller spots on lips, on side and underside of head and body. Dorsal and anal light, dark towards the upper margin of the fins, and with rows of black spots. Caudal violet, with rows of black spots. Pectorals with transverse rows of black spots. Ventrals creamy, violet-brown towards their tip. In another specimen the spots, forming the blotches along the sides and on the opercle, and also those forming the band on the head, are diffuse. In smaller specimens the blotches are smaller and consist of smaller spots; the blotches are arranged in two alternating rows in the second half of the body: one above and one below the lateral line. The fins are much darker and the pectorals are black, with irregular white dots and stripes.

29. *Ophiocephalus lucius* C.V.

Seven specimens, 86 - 380 mm.

30. *Ophiocephalus micropeltes* C.V.

Twenty-six specimens, 40 - 78 mm.

These juvenile specimens have only about 70 scales in the lateral line, which is very low.

31. *Anabas testudineus* (Bl.).

Five specimens, 74 - 80 mm.

32. *Polyacanthus hasselti* C.V.

Nine specimens, 82 - 111 mm.

Two specimens, 82 and 87 mm, from the same locality differ from the others in being of a sepia colour. Many scales of the body with a narrow dark hindborder, giving to the sides a reticular appearance. A diffuse dark blotch at base of soft dorsal. Moreover the lateral line is continuous, showing only a bend downwards at the point where the lateral line is generally interrupted. The interruption of the lateral line varies a good deal in this species. Sometimes the lateral line ends abruptly, and is continued a few scales lower, but often the continuity is only broken by one scale without tube.

33. *Sphaerichthys osphromenoides* Can.

Two specimens, 30 and 34 mm.

34. *Betta anabatoides* Blkr.

Fourty-six specimens, 30 - 116 mm.

Among this material there are five specimens, 62 - 92 mm, in which the anal spines are weak, but this may be due to prolonged conservation in formaline. In five other specimens however, 62 - 116 mm, there is a distinct dorsal spine and this character would bring them in quite a different group of the genus *Betta*. I have long hesitated if I ought to create a new species for these specimens, but otherwise they agree so completely with the other

specimens in fin- and scale-counts as well as in the colour-markings, that I have come to the conclusion that the development of a dorsal spine may occur or not in the same species. Possibly the presence or absence of a dorsal spine may be a sexual character. It may be worth noticing that excepting one, the specimens with a dorsal spine are larger than those without.

As said above, all the specimens are alike in colour-markings and this is, I think, not without importance as their coloring differs from what I have seen in specimens of this species from other localities. In all, small and large, there is a double row of black spots, each spot on one scale, along the belly and above the anterior part of the anal fin. Besides, the young ones have distinct longitudinal bands, as Hardenberg (10) also describes, and traces of these bands are sometimes visible in older specimens.

35. *Trichopodus trichopterus* (Pall.).
Fifteen specimens, 51 - 94 mm.

36. *Luciocephalus pulcher* (Gray).
Six specimens, 52 - 134 mm.

37. *Nandus nebulosus* (Gray).
Sixteen specimens, 58 - 137 mm.

38. *Pristolepis fasciatus* (Blkr.).
Two specimens, 62 and 94 mm.

39. *Pristolepis grooti* (Blkr.).
Thirty-seven specimens, 58 - 123 mm.

40. *Tetrodon* (*Crayracion*) *palembangensis* Blkr.
One specimen, 142 mm.

41. **Mastacembelus billitonensis** n. sp.
D.XXX.56-60. A.III.57-69. P.22. Ll.about 220.Ltr. (between D. and origin of A.) about 36.

Height at origin of anal 8.4 - 12 in total length. Head 6.2 - 7.9 in total length. Eye 12 - 15, situated in the anterior half of the head. Maxillary reaching to below nostrils. Head scaly, excepting above, the scales of the nape reaching anteriorly to above the hind margin of the preopercle. A distinct, flat, triangular preorbital spine. Preopercle without spines. The distance of the origin of the dorsal from the head is equal to the length of the head without snout. Dorsal spines slightly increasing in length posteriorly; the 29th spine much longer than the others and equal to twice the diameter of the eye. Last dorsal spine minute, hidden below the skin. Soft dorsal with a thick membrane, the rays therefore difficult to count, specially posteriorly. No notch between dorsal and caudal. Anal spines close together, at a short distance behind anus, which is situated halfway between tip of snout and tip of caudal. First and second anal spines minute, second as long as snout without proboscis. A very slight notch between anal and caudal. Caudal rounded. Pectorals rounded, more or less than three times in length of head. Lateral line conspicuous, interrupted at several places

of its course, running along upper part of sides on body, and on middle of sides of tail. Colour of preserved specimens light reddish brown. Sides of body and tail with dark brown or blackish transverse blotches, fusing or forming cloudy markings on the back, and tapering into narrow transverse bands towards the belly; sometimes bifurcating or anastomosing with the neighbouring bands. Similar but somewhat broader bands on the isthmus and on the lower side of the head. Upperside of head dark, with a more or less distinct light band from eye to above the extremity of the opercle or continued a little way along the back. Soft dorsal, anal and caudal with a white margin; the rest of the dorsal and anal transversely banded, the bands of the tail continued on the fins. In large specimens these bands have fused and the fins are uniform, blackish with a white margin. Pectorals white, with irregular dark vertical bands.

Three specimens, 236 - 338 mm.

Besides these specimens there are three specimens, 78 - 218 mm, in the collections of the Zoological Museum of Amsterdam, collected by Dr. KARNY in 1921 in the Wai Lima, Lampong District, Sumatra. They agree with the specimens from Billiton, but being smaller, the colour-markings are more distinct than in those from the typical locality.

This species is nearest to the Siamese *M. circumcinctus* HORA (11, p. 475) and *M. taeniagaster* FOWLER (9, p. 136), which is only a colour-variety of the former, but *M. billitonensis* differs in being more slender, with a longer tail and with more rays in the dorsal and anal, and in having the hind border of the preopercle smooth.

II. Ecological and Zoogeographical Part.

Billiton is a low island, most of it being below 100 m above sea-level and only a few hillranges attain greater height, up to 500 m. Torrential species are therefore not to be expected, and the species collected belong to those, which are merely found in ponds and rivers of the lowland. On my request Mr. KUIPER kept apart, as far as possible, the species collected in the lower-, middle, and upper course of the rivers and it may be of interest to publish the results of this attempt to an ecological classification of the freshwater fishes of this island.

The species exclusively found in the lower course of the rivers are *Megalops cyprinoides, Fluta alba* and *Anabas testudineus.* The first of these three is a marine species, entering estuaries, the second is known to occur in freshwater as well as in brackish water, and *Anabas testudineus,* the Climbing Perch, is a species with a wide ecological valence. From the other species, collected in the lower course, three have also been found in the middle course, viz. *Clarias nieuhofi, Trichopodus trichopterus* and *Luciocephalus pulcher.* One species, the common *Ophiocephalus striatus,* inhabits the whole river from lower to upper course.

The middle course yielded the greatest number of species. Exclusively in this part the following have been found: *Silurichthys phaiosoma, Aoria nemurus,*

Rasbora dorsiocellata, Puntius lateristriga, Puntius fasciatus, Ophiocephalus bankanensis, Polyacanthus hasselti, Betta anabatoides, Nandus nebulosus, Pristolepis fasciatus and *Pristolepis grooti*. In the middle and in the upper course the following species were caught: *Rasbora cephalotaenia, Rasbora einthoveni, Rasbora pauciperforata, Puntius binotatus* and *Ophiocephalus lucius*. Only two species seem to be restricted to the upper course of the rivers: *Rasbora lateristriata* and *Sphaerichthys osphromenoides*. The former is a species of a wide ecological and geographical range, the second seems to be rather rare everywhere and therefore it may well be a stenotopic species.

Now that, thanks to the investigations of Mr. KUIPER, our knowledge of the freshwater fauna of Billiton has made a good advance, it is of interest to consider it from a zoogeographical point of view.

As has been first pointed out by MAX WEBER (14), the freshwater fish fauna of West Borneo shows more affinity to that of East Sumatra than to East Borneo, the explanation being that during the pleistocene ice-age so much water was assembled in the polar regions in the form of ice, that the sea level in the tropics was considerably lowered. According to MOLENGRAAFF (14) the recession of the sea was such, that the present shallow Sunda Sea, now separating the Greater Sunda Islands, changed into dry land, and the rivers of East Sumatra and West Borneo continued their course on this Sundaland and united into a big stream, which probably discharged into the South China Sea.

In pleistocene times therefore the rivers of West Borneo and East Sumatra had a much longer course than now, and they were in communication with each other. Probably the conditions for the origin of new species were favorable and we may assume that the species now living in these rivers, but not occurring in those of West Sumatra and East Borneo, originated in the drainage system of the pleistocene Sundaland or invaded that area in those times. They belong to what I have called (1) a young pleistocene fauna in contrast to those, which are also found in West Sumatra or East Borneo, and which must belong to an older fauna.

Billiton and Banka must have risen out of the plains of the Sundaland as monadnocks and the water of their rivers must have mixed with those of the Sundaland.

During pleistocene times an intermingling of the freshwater fauna of Billiton with that of Sumatra, Banka, and Borneo must have been possible, and if these postulations are correct we may expect that the present fishfauna of Billiton shows a great similarity with that of the other islands just mentioned.

The collections of Mr. KUIPER contain 41 species. Two of them, *Clarias batrachus* and *Clarias teysmanni* occur with a query in the list. The first has been mentioned by BLEEKER as an inhabitant of Billiton and we may therefore retain it in the list of the true freshwater fishes of that island, but it is safer to leave the second species out of consideration, as being a doubtful case. We also omit *Megalops cyprinoides* from our list, as it is a marine species. This

brings the number of species to 39. We must however add the 6 species recorded by BLEEKER but not collected by Mr. KUIPER, and so we come to a total of 45 species, which we can group as follows: [1])

Billiton,	Banka,	Sumatra,	Borneo......	28 species.
Billiton,	— ,	Sumatra,	Borneo......	9 species.
Billiton,	— ,	Sumatra,	—	4 species.
Billiton,	Banka,	Sumatra,	—	1 species.
Billiton,	Banka,	— ,	Borneo......	2 species.
Billiton,	— ,	— ,	—	1 species.
			Total......	45 species.

It appears now that one species is endemic: *Nemachilus kuiperi* n. sp. From the remaining 42 occur in Sumatra (93.3 % of the total), 39 in Borneo (86.7 %) and 31 in Banka (68.4 %). All species, excepting of course the endemic one, occur either in Sumatra or Borneo and 37 species (82.2 %) are common to both islands. This is in accordance with our expectation.

Geologically Banka and Billiton are very similar, and there is reason to suppose that they are the remains of an old landmass. In the freshwater fish-fauna there is nothing to support this. The percentage of species Billiton has in common with Banka is less than that of those common to Billiton and Sumatra or Borneo, and all species known from Banka and Billiton also occur either in Sumatra or in Borneo. Also, when we group the species Billiton and Banka have in common according to their probable age, we find that two thirds may belong to the "old" fauna and one third to the "young" or pleistocene fauna, which is the same percentage as that of the species Billiton has in common with Sumatra or Borneo.

The affinity of the fishfauna of Billiton to that of Sumatra is somewhat greater than to that of Borneo. The following species have been found in Sumatra, but not in Borneo: *Rasbora dorsiocellata, Rasbora pauciperforata, Sphaerichthys osphromenoides, Mastacembelus billitonensis* and *Betta picta*. Only the last-named species has also been found on Banka. With Borneo Billiton has two species in common, not known from Sumatra: *Hemirhamphodon phaiosoma* and *Ophiocephalus bankanensis,* both occurring on Banka.

The same slight predominance of the Sumatra-element over the Borneo-element is also apparent in other groups of the fauna (see RENSCH (15) p. 78-81).

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3. — ibid. III, 1852, p. 87 - 100.

[1]) The range outside Sumatra, Borneo, and Banka has not been considered.

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CRITICAL NOTES ON THE MALAYSIAN SPECIES OF *IDIONYX*, HAGEN (Odon.).

By

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Through the kindness of Monsieur A. BALL, of the Brussels Museum, I have been able to examine the type of *I. yolanda,* described by SELYS from Singapore. Besides this typical specimen, Dr. H. WEIDNER, of the Hamburg Museum, has forwarded to me a single male of an *Idionyx* from W. Borneo, which I had identified as early as 1929 as *dohrni,* with some misgivings. Among the Odonata collected for me in 1932 and 1933 by Mr. KENZO KUWASIMA on Basilan I. (Southern Philippines), is a single female of an *Idionyx* which I left unnamed so far, but by more intense analysis of old material it could be definitely classified. Now that I have also seen two females from the Malay Peninsula (including the type of *yolanda,* SELYS), a male from the island of Billiton, and lastly, a fine couple of apparently quite the same species, captured in E. Borneo, I propose to deal with all these specimens more thoughtfully.

Before proceeding to a discussion of these insects, I wish to thank Dr. A. KÄSTNER, of the Stettin Museum, for the loan of KRÜGER's type specimens of *I. dohrni,* from N.E. Sumatra.

Idionyx yolanda SELYS (fig. 1 - 2).

1871. SELYS, Bull. Acad. Belg. (2) 31, p. 520 - 521. — ♀ Singapore.
1899. KRÜGER, Stett. Ent. Zeitg. 60, p. 326 - 330. — ♂♀ N.E. Sumatra (*dohrni*).
1902. LAIDLAW, P. Z. S. London, p. 78 pl. 5 fig. 4 (♀ insect). — ♀ Kwala Aring (*dohrni*).
1907. MARTIN, Cat. Coll. Selys, Cordul. p. 80: "Sumba, Java" (error), "Birmanie" (error), "Singapoure" (*yolanda*); ibid. p. 81 - 82: "Sumatra, Peninsule malaise" (*dohrni*).
1912. RIS, Supplem. Entom. 1, p. 81. — Remarks (*dohrni* + *yolanda*).
1913. LAIDLAW, P. Z. S. London, p. 67 - 68 (key with *dohrni*), pl. 4 fig. 4 (♀ apex abd.). — ♂ Sarawak (*dohrni borneensis*).
1914. MARTIN, Gen. Ins. Cordul., p. 9 pl. 3 fig. 24 (♀ insect, type): „Indo-Chine, Java, Sumba" (error) (*yolanda*); ibid. p. 9: "Sumatra, Singapoure" (*dohrni*).
1926. FRASER, Rec. Ind. Mus. 28, p. 197 - 198 (key ♀), 201 (discussion, not seen) (*yolanda*); ibid., pl. 9 fig. 3 (♂ apps.), pl. 10 fig. 3 (♂ genit.) (*dohrni*).
1927. RIS, Zoöl. Meded. Leiden, 10, p. 36 (remarks: *dohrni borneensis* = *montana*?).
?1931. LAIDLAW, J. Fed. Mal. States Mus. 16, p. 218 - 219. — Peninsular examples of doubtful identity (*yolanda*).
?1934. SCHMIDT, Arch. Hydrob. Suppl. 13, p. 377. — ♂ S. Sumatra (*dohrni,* doubtful).
1935. LIEFTINCK, Misc. Zool. Sum. 92 - 93, p. 18. — Sumatra, notes (*dohrni*).

Material examined: — 1 ♀ ad., labelled: "SING. 33" (round white label), "Mal. W." (square yellow label, SELYS's hand), "*Idionyx yolanda* Type", Revision Martin 1906, "Fig. Gén. Ins." (printed). Holotype in the Brussels Museum. — 1 ♀ ad., labelled: "C. J." (Camp Jor, Alb. GRUBAUER leg.), "*Idionyx dohrni?*" (FÖRSTER's hand), no. 1893 of the FÖRSTER collection, Michigan Museum, Ann Arbor. — 1 ♂, 1 ♀ ad., bearing the printed labels: "Dohrn/Sumatra/ Soekaranda", and: "*Idionyx dohrni* Krüger, L. Krüger determ. 1927 in KRÜGER's handwriting). Holo- and allotype *dohrni*, in the Stettin Museum (♂ head and prothorax wanting). — 1 ♂ semiad., N.W. Billiton, Ajer Gelarak, 27.XII.1936, F. J. KUIPER leg., in the Buitenzorg Museum. — 1 ♂ ad., Central W. Borneo, Lebang Hara, 25.XI-5.XII.1924, Sammelreise Prof. Dr. H. WINKLER ded. 1924 - 1925, in the Hamburg Museum. — 1 ♂, 1 ♀ ad., E. Borneo, Sangkoelirang, Palawan Besar, V.1937, and Palawan Ketjil, VI.1937, Mrs. M. E. WALSH leg., in the Buitenzorg Museum. — 1 ♀ ad., labelled: "Bukau, N. Borneo" (yellow label, SELYS's hand), identified as *dohrni* by MARTIN 1906, in the Brussels Museum. — 1 ♀ ad., Philippine Is., Basilan I., Maloong, 15.V.1933, K. KUWASIMA leg., in the author's collection.

Male. — The colouring of the head of our Bornean individuals corresponds closely with KRÜGER's description (and with the type of his species as well); I cannot detect any appreciable difference in the shape of the yellow stripes of the thoracic sides between the type of *dohrni* and our examples from Billiton and Borneo. In all of them the antehumeral bands are replaced by a very indistinct, dirty ochreous spot, just dorsal to the mesinfraepisternites, the posterior halves of which are band-like and bright yellow in colour. The specimen from the island of Billiton is slightly immature.

The coxae of the first pair of legs are entirely yellow, those of the second pair are brownish anteriorly but otherwise also yellow, while the yellow colour of the hinder pair is restricted to the distal third of the coxae. Trochanters of first pair clear yellow, of second pair yellow-brown, of third pair black. All femora brownish-black. Tibiae of first pair brownish-black, of second and third pair clear yellow, obscured basally. Tarsi blackish, exterior surfaces of first joint with a clear yellow streak. Tarsal claws reddish. Tibial lamina of first pair of legs clear yellow, extending along the distal $^{5}/_{7}$ of the length of tibia.

Wings hyaline (bases tinged with pale yellow in the immature male from Billiton). Neuration identical in our four males. There are 2 *Cux* in the hind wings (KRÜGER's "Medianadern" are cubito-anal cross-veins). Nodal indices: $\frac{5.13.13.6}{7.\ 8.\ 8.8}$ (type *dohrni*), $\frac{6.13.13.6}{7.\ 9.\ 8.7}$ (Billiton), $\frac{5.12.12.6}{8.\ 8.\ 8.7}$ (Lebang Hara), $\frac{6.13.13.6}{9.\ 9.\ 9.9}$ (Sangkoelirang). Proximal side of *t* in front wing a little shorter than, or equal in length to, the costal side. Only 1 row of discoidal cells in both pairs of wings, in the front wings to beyond level of nodus, in the hinder pair up to the nodus; marginal cells $\frac{4-6}{5-7}$. Anal loop containing 7 cells.

The yellow marks of the abdomen are much reduced. Segm. 1 carries a

small yellow spot in the postero-lateral corner, and there is a broad yellow band bordering the tergal margin of segm. 2. Lower margins of the succeeding segments also with a very fine yellow line, progressively smaller from segm. 4 backwards; along the tergal margin of 7 - 9 this line is broader and sharply defined, extending along full length and widest on 8. Segm. 10 and appendages black.

The fine bunch of downwardly projecting yellow-brown hairs on the underside of segment 7, at the junction of its middele and distal thirds [1]), is present in all specimens examined by me. A similar, though smaller, tuft of hairs occurs on the underside of segment 8.

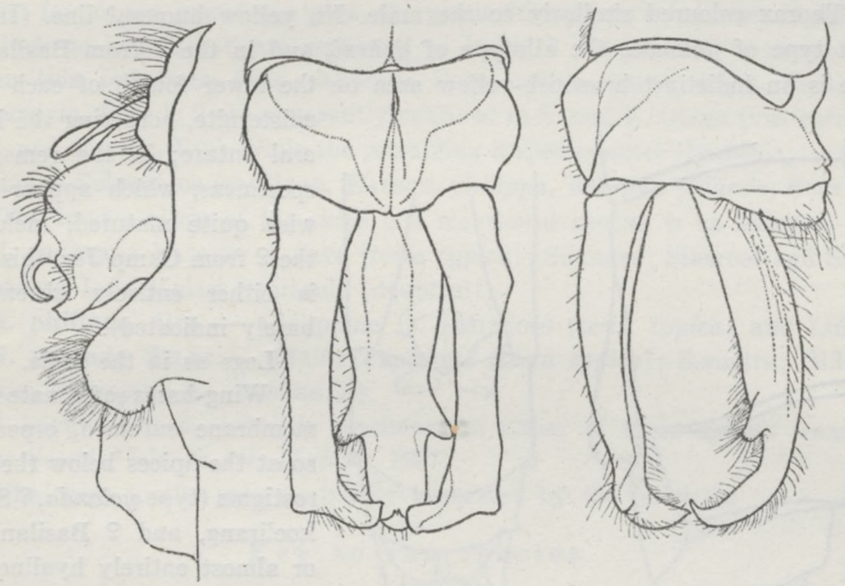

Fig. 1. *Idionyx yolanda* SELYS, E. Borneo. Male genitalia, left side, and anal appendages, dorsal view and right side.

Genitalia of 2nd abdominal segment and anal appendages shaped as is shown in fig. 1.

Female. — The Malayan specimen, the single ♀ from Sangkoelirang, the specimen in the Brussels Museum from Bukau, N. Borneo, and the solitary ♀ from Basilan I., in the Philippines, are clearly examples of the same form as the one described by KRÜGER as *dohrni*. Having now confronted this small series with the type of *yolanda*, described by SELYS in the 'Synopsis', I cannot find any characters by which to distinguish the Singapore specimen of *yolanda* from the others, and I have no doubt but that all our specimens are correctly referred to the present species.

The ♀ of *I. yolanda* differs but slightly from that of *montana*, KARSCH. Both species agree very closely in details of colouring; but *yolanda* is distinctly

[1]) First mentioned by LAIDLAW (loc. cit. 1913). It is also present in *montana*.

a smaller insect, and a slight difference is to be noted in the shape of the posterior metallic-green band which covers part of the thoracic sides. In *montana* this band broadens considerably — though evenly — from near the lower anterior corner of the metepimerum upwards, and the posterior limit of the band appears evenly concave. In *yolanda,* however, this band, although being of about the same width ventrally, broadens rather abruptly so as to become distinctly angulated at a point slightly dorsal to the middle of its length.

The vertical tubercle of the head is unarmed, flatly rounded in frontal view, and identical in shape in the two species. The occipital triangle is black, simply rounded, polished above.

Thorax coloured similarly to the male. No yellow humeral line. (In the adult type of *yolanda,* the allotype of *dohrni,* and in the ♀ from Basilan I., there is an indistinct brownish-yellow area on the lower fourth of each mesepisternite, bordering the humeral suture; in the remaining specimens, which appear likewise quite matured, including the ♀ from Camp Jor, this spot is either entirely absent or barely indicated).

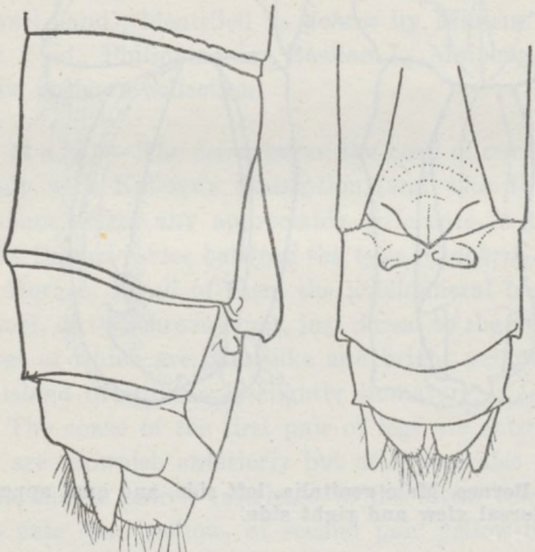

Fig. 2. *Idionyx yolanda* SELYS, Type *dohrni* KRÜGER, N.E.Sumatra. Apex of female abdomen, right side and ventral view.

Legs as in the male.

Wing-bases saffronated and membrane enfumed, especially so at the apices below the pterostigma (type *yolanda,* ♀ Sangkoelirang, and ♀ Basilan I.); or almost entirely hyaline, the bases saffronated to a variable extent (♀ Camp Jor and allotype *dohrni*). Neuration much as in the opposite sex. Discoidal field with a single row of cells to beyond level of nodus in front wings, up to the nodus in the hinder pair of wings. Nodal indices: $\frac{5.13\ 13.5}{7.\ 8.\ 8.7}$ (type), $\frac{6\ 13.12.6}{8.\ 8.\ 9\ 8}$ (Camp Jor), $\frac{6\ 13.13.6}{9.\ 8.\ 8\ 8}$ (Sangkoelirang), $\frac{6.14\ 13.7}{9.\ 9.\ 9\ 8}$ (allotype *dohrni*), $\frac{7\ 12\ 13.6}{8\ 8.\ 9\ 7}$ (Basilan I.). Anal loop consisting of 8 - 10 cells (8.7 in the type of *yolanda*). Three basal cells between the anal loop and the margin of the wing, and only two cell-rows between them from a level half-way the length of the anal loop outwards.

In both front wings of the ♀ from Camp Jor there are two cross-veins in the supratriangle. Pterostigma black, or brownish-black.

Legs coloured as in the opposite sex.

Abdomen black. Segm. 1 with a small latero-ventral, posterior, yellow spot; 2 with a yellow stripe along the lower margin, which broadens rather abruptly towards the base of the segment; 3 - 8 with a fine yellow line bordering the tergites ventrally and most conspicuous on 7 - 8; 9 - 10 and appendages black.

Valvula vulvae black, very small, shaped as is shown in fig. 2, not differing from that of *montana*.

Length: ♂ abd. + app. 28, hw. 27.5 (type *dohrni*); 28.5, 28 (Billiton); 28.5, 28 (Lebang Hara); 29, 28 (Sangkoelirang). ♀ 27.5, 29 (type); 26, 27.5 (allotype *dohrni*); 29, 30.5 (Camp Jor); 26.5, 29 (Sangkoelirang); 26.7, 28 mm Basilan I.).

So far as my knowledge goes, the genus *Idionyx* now includes 19 species, of which no less than 9 are restricted to India, 5 are peculiar to Assam and Burma (viz. *imbricata,* FRAS., *intricata,* FRAS., *optata,* SELYS, *selysi,* FRAS., and *unguiculata,* FRAS.); 2 are apparently confined to S. and E. China (viz. *carinata,* FRAS. and *claudia,* RIS), while the remaining 3 species enter the Malaysian and Philippine Subregions (*montana,* KARSCH, *philippa,* RIS and *yolanda,* SELYS).

The known range of the three last mentioned species is as follows:—

I. montana KARSCH. — Java (*terra typica*); Sumatra; Siberoet and Sipora (Mentawei Is.); Malay Peninsula (doubtful!).

I. philippa RIS. — Philippine Is. [Mindoro (*terra typica*) and Luzon].

I. yolanda SELYS. — Malay Peninsula (*terra typica*); Sumatra; Billiton; Borneo; Philippine Is. (Basilan I.).

I have not seen authentic specimens of either of these species from the Lesser Soenda Islands (cf. MARTIN, 1907).

The three species may be briefly separated by the following

Key to the species.

1. Thorax with an incomplete, narrow, citron-yellow stripe on each side at level of the spiracle, ceasing at a point immediately dorsal to it. Metepimeron with an almost circular yellow patch in the antero-ventral corner and a smaller spot of the same colour along ventral margin in the posterior corner of the said space. Wing-bases brownish golden-yellow. Abd. 30, hw. 30 mm. Male unknown .... *philippa.*
(RIS, Supplem. Entom. 1, 1912, p. 80, 81 - 82, Fig. 16-wings ♀).

1'. Thorax with two continuous yellow bands on each side, one at level of the spiracle and another one on the posterior border of the metepimeron. Wings hyaline or deeply saffronated, bases at most slightly tinged with golden-yellow.

2. Posterior metallic-green band covering part of the metapleurae evenly widened from near the lower anterior corner of the metepimeron upwards; posterior limit of this band evenly concave (♂♀) [1]. Distal portion of ♂ superior anal appendages without extero-lateral tooth-

[1] In specimens of *montana* (♂ and ♀) from Benkoelen (S. W. Sumatra), however, the shape of the metallic-green band does not differ much from that of *yolanda*.

like projection; apices gently incurvate and provided on their outer margin with a tuft of long, golden-yellow pencil-like hairs. Appendix inferior without lateral spines. (Cf. MARTIN, l.c. 1907, Fig. 95). *montana.*

(KARSCH, Entom. Nachrichten, 17, 1891, p. 27).

2'. Posterior metallic-green band covering part of the metapleurae distinctly angulated ventrally at a point slightly dorsal to the middle of its length (♂♀). Distal portion of ♂ superior anal appendages more abruptly inwardly bent, with a distinct, blunt, extero-lateral tooth; apices beyond the nod longer and slender, no conspicuous tuft of hairs on outer margin of same. Appendix inferior with a stout marginal tooth on each side beyond the middle of its length (fig. 1). *yolanda.*

The Malaysian species of *Idionyx* are rare insects, breeding in forest-streams of the lower mountain zone. In South Sumatra we took *I. montana* over a stream at about 500 metres above sea-level. In Java this species is usually found at higher altitudes (500 - 1000 m). It has decidedly gregarious habits and the males are sometimes found flying in swarms at about five to ten metres in the air over forest-paths and in glades in deep ravines. Apparently they fly only during sunlight, indulging in swift erratic flights.

The specimens of *I. yolanda* from Billiton and Borneo were taken in low country.

The larva of *Idionyx* is quite unlike that of *Macromia* and has the legs much shorter than in species of that genus. Recently, NEEDHAM and GYGER have published a description and sketches of the supposed larva of *I. philippa* RIS (Philipp. Journ. Sci. 63, 1937, p. 59 - 60, pl. 8 fig. 93 - 95).

PRELIMINARY DIAGNOSES OF NEW BIRDS FROM MALAYSIA.

By

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(Director, Raffles Museum, Singapore).

Pteruthius flaviscapis leuser subsp. nov.

Female like the continental *aeralatus* above, that is with less chestnut on the inner secondaries, than in the Sumatran *cameranoi*, but the under parts deeply buff as in this last named race.

Type. — Female, collected on Mt. Leuser, Atjeh, North Sumatra, 900 - 2000 metres, on 8th February, 1937. Mus. Buitenzorg, No. 10200.

Specimens examined. — A male and a female, compared with long series of the two most closely allied races. These North Sumatran birds seem to represent a race exactly intermediate in characters between the two races found on the Malayan and South Sumatran mountains.

Oriolus maculatus edgari subsp. nov.

Like *O. m. maculatus* of Java, but the bill larger.

Type. — Adult female, collected on Singapore Island, on 26th April, 1937. Raffles Museum.

Remarks. — Although it has not hitherto been realized, there is a breeding race of this oriole in the south of the Malay Peninsula. In winter its range is invaded by large numbers of the migratory *diffusus*. This breeding race is very like the resident bird of Java. Mr. HOOGERWERF's collection now confirms the conclusion arrived at by Dr. G. C. A. JUNGE and myself in Leiden last year that the Sumatran race is also the large-billed form. In this case I have selected a Malayan bird as the type as it seems that the racial character is slightly more pronounced in Malayan than in Sumatran examples. Mr. A. T. EDGAR was the first to find the nest in the Malay States.

Cyanoderma rufifrons sarawacensis subsp. nov.

Nearest to *C. r. poliogaster* of the Malay States and Sumatra, but the crown slightly more orange and less chestnut; and the lores and anterior part of the supercilium grey, not whitish.

Type. — Adult male, collected on Mt. Poi, West Sarawak, 4 - 5000 ft., by E. BANKS. Sarawak Museum.

Remarks. — Mr. HOOGERWERF was fortunate in getting an example of this very rare babbler on his expedition. The fresh skin has enabled me to adjudge the degree to which the few available skins are likely to have been altered by

fading. A second Bornean specimen comes from the Ulu Trusan in North Sarawak.

Terpsiphone paradisi madzoedi subsp. nov.

Nearest to *T. p. insularis* of Nias Island, but the abdomen white, not grey.

Type. — Adult male, collected at Lesten, Atjeh, North Sumatra, 700 metres (*c.*), on 18th March, 1937. Mus. Buitenzorg, No. 11594.

Remarks. — The finding of a grey-headed race of this flycatcher on the mountains of North Sumatra is another of Mr. HOOGERWERF's more interesting discoveries. Two males and a female (all in the brown phase) have the entire head, neck and breast grey, with the crown only slightly darker than the cheeks and throat. In the adjacent lowlands of North-East Sumatra a black-crowned race is found (*T. p. indochinensis*).

At Mr. HOOGERWERF's request I have associated this new race with the name of a diligent Sundanese collector who accompanied the expedition to Atjeh.

Erpornis zantholeuca saäni subsp. nov.

Nearest to the Bornean race *E. z. brunnescens*, but the upper parts less yellow and more deeply green: cap, darker.

Type. — A female collected near Pendeng, Atjeh, North Sumatra, 500 - 800 metres, on 19th February, 1937. Mus. Buitenzorg, No. 10300.

Remarks. — This specimen seems to be the first recorded example of the species from the island of Sumatra. It needs no comparison with its nearest neighbour, the very much yellower *interposita* of the Malay Peninsula. It has been compared with long series of *brunnescens*.

The subspecific name is in recognition of the valuable services rendered by another of Mr. HOOGERWERF's collectors.

TWO NEW MAMMALS FROM NORTH SUMATRA.

By

F. N. CHASEN

(Director, Raffles Museum, Singapore).

The following short descriptions are published as a preliminary to a more detailed paper on the mammals collected by Mr. A. HOOGERWERF at various places in the environs of Mt. Leuser, and on the mountain itself in the Government of Atjeh, North Sumatra, in 1937. I am grateful to the Director of the Zoological Museum, Buitenzorg, for the privilege of examining this very interesting collection.

Rattus hoogerwerfi sp. nov.

Characters. — A brightly coloured, brown rat of medium size, with long soft pelage. The tail is longer than the head and body, and white for the distal half. The nasals and the interorbital region of the skull are unusually flattened.

Type. — Adult female, skin and skull, collected at Blang Kedjeren, Atjeh, North Sumatra, 800 metres (*c.*), on 29th January, 1937. Mus. Buitenzorg, No. 311.

External measurements (taken in the flesh). — Head and body, 189; tail, 257; hind-foot (s.u.), 37; ear, 26 mm.

Skull. — The skull has the brain case much inflated as in the *surifer* rats: the interorbital region is slightly hollowed between the supraorbital beading, and the region about the posterior end of the nasals is quite flat. *Measurements.* — Total length, 41.6; condylo-basilar length, 36; palatilar length, 19.5; zygomatic breadth, 20.4; greatest breadth of brain case (base of zygomata), 18; median length of nasals, 14.5; breadth of combined nasals, 5; least interorbital breadth (inside beadings) 3.8; length of anterior palatal foramina, 7.8; upper molar row (alveoli), 7.5 mm.

Pelage. — The fur is very soft and long, and excluding the numerous long, projecting black piles, is about 20 mm thick on the rump. Upper parts, rich, bright brown, sprinkled with black, becoming paler on the flanks and paling to rufous-buff on the under parts with no sharp line of demarcation. Base of the fur everywhere, broadly grey. Under side of the head, grey. Whiskers, long and black. Feet, blackish, but the digits of the forefeet, white. The juvenile is much duller in colour and nearer to liver-brown on the upper parts. Tail with about ten rings to the centimetre.

Mammae. — The unusual formula of 1 — 3 = 8.

Specimens examined. — Four females (one juvenile) from Blang Kedjeren, and Mts. Leuser and Ngo Lemboeh.

Remarks. — This very distinct species of rat seems to require no close comparison with any other Malaysian form. In its parti-coloured tail and in the trough-like frontal region of the skull it bears some resemblance to *Rattus* (*Lenothrix*) *canus,* but this latter form is a grey rat with short, harsh pelage, and the skull seen from below presents many important points of difference when compared with that of *hoogerwerfi* (shorter and differently shaped palatal foramina, larger teeth, narrower palate, smaller and differently shaped bullae; rounded and encroaching interpterygoid space etc.). Perhaps the nearest relative of *R. hoogerwerfi* is *Rattus baluensis korinchi.* If consideration of the tail is excluded, the two forms have some superficial resemblance to each other, and the peculiar characters of the skull of *hoogerwerfi* are to some extent adumbrated in adults of *korinchi.*

Rattus bukit lieftincki subsp. nov.

Intermediate in characters between typical *bukit* from the Malay Peninsula, and *treubii* from West Java. In colour much brighter than *bukit,* and nearer to *treubii,* but with the insides of the thighs mostly white, not coloured. The skulls of adults average smaller than in *bukit,* but larger than in *treubii.*

Type. — Adult female, skin and skull, collected at Atang Poetar, Atjeh, North Sumatra, 1000 metres (*c.*). Mus. Buitenzorg, No. 478.

Measurements. — Head and body, 150; tail, 194; hind-foot (s.u.), 29; ear, 19 mm. *Skull.* — Total length, 37; condylo-basilar length, 30.8; diastema, 9; upper molar row (alveoli), 6.3; length of palatal foramina, 6.1; zygomatic breadth, about 17 mm.

Remarks. — Fourteen examples of this new form have been compared with good series of the allied Malaysian races. The first, and hithertho only record of the species from Sumatra is of a skin without skull referred to *"Rattus bukit"* by ROBINSON and KLOSS in Journ. Fed. Malay States Mus. VII, 1919, p. 317.

I have associated this interesting new form with the name of the courteous acting Director of the Zoological Museum at Buitenzorg in recognition of helpful collaboration with the Raffles Museum.

MOOSBEWOHNENDE THEKAMOEBE RHIZOPODEN VON JAVA UND SUMATRA.

Von

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INHALT.

I. EINLEITUNG.

Während der letzten Zeit haben wir uns beschäftigt mit dem Studium der thekamöben Rhizopoden-Assoziationen einer Reihe von Moosproben (*Bryales* und *Sphagnales*) aus verschiedenen Teilen der Welt: Europa, Ostasien, Niederländisch-Ostindien, Neuseeland, Nord- und Südamerika. Es war dabei unsere Absicht, erstens unsere Kenntnis dieser Tiergruppe zu vervollständigen durch das Studium von uns zwar aus der Literatur bekannten, bisher von uns aber niemals beobachteten Arten, speziell der südlichen Hemisphäre, zweitens die Kenntnis der schon früher studierten Arten zu erweitern und drittens die so gewonnene Erkenntnis zu benutzen zur Vergleichung dieser Assoziationen mit denen unseres eigenen Untersuchungsgebietes und mit denjenigen, welche frühere Beobachter in diesen fernen Gegenden schon entdeckt hatten. Dazu wurde die gesamte diesbezügliche Literatur, soweit sie uns zugänglich war, sorgfältig studiert; zum Teil war dieselbe schon bei vorigen Untersuchungen benutzt und uns daher bekannt. Ausserdem waren wir aber dadurch genötigt, einige, besonders neuere Arbeiten zum ersten Male zu berücksichtigen. Auch das war ein Gewinn; leider konnten wir einige dieser Arbeiten nicht aus eigener Anschauung kennen lernen, weil sie an uns unzugänglichen Stellen publiziert worden waren und müssen wir uns daher dazu beschränken, diese aus zweiter Hand zu zitieren oder ganz unberücksichtigt zu lassen.

Bei der Ausarbeitung der Resultate dieser Untersuchung wurde es uns deutlich, dass der Umfang in einem solchen Maasse gewachsen war, dass es erwünscht erschien, die Arbeit in einige kleinere Teile aufzuteilen, deren jeder für sich das Material einer einzigen der genannten Gegenden umfasste. So veröffentlichen wir hier, auf einer verehrenden Einladung der Redaktion der „Treubia", die Bearbeitung des ostindischen Materiales; die der übrigen Proben wird an einer anderen Stelle erfolgen.

Die gesonderte Bearbeitung der ostindischen Rhizopoden hatte auch noch den Vorteil, dass dadurch eine Vergleichung unserer Resultate mit denjenigen von HARNISCH bei den Süsswasserrhizopoden der Deutschen limnologischen Sunda-Expedition am besten möglich war und ausserdem noch einige kleinere Arbeiten darüber berücksichtigt werden konnten. Zwar stammt das HARNISCH'sche Material wenigstens zum Teil aus anderen und sehr speziellen Biotopen, sodass zu einer allzu weitgehenden Parallelisierung kaum Anhaltspunkte vorliegen. Weil wir aber der Annahme eines sehr engen Konnexes zwischen den Assoziationen der Süsswasserrhizopoden und dem von ihnen bewohnten Milieu noch immer etwas skeptisch gegenüberstehen und jedenfalls einige der von HARNISCH studierten Proben — wie alle unsrige — ebenfalls Moose sind, entweder bodenständige oder baumbewohnende, so lohnte es immerhin die Mühe, unter einigem Vorbehalt die auffallendsten Kongruenzen und Differenzen herauszuschälen.

Das Material zur vorliegenden Untersuchung lieferte uns eine Reihe von Moosproben, welche auf verschiedene Weise in unseren Besitz gelangt waren. Einen Teil bekamen wir durch Kauf von Herbariumpflanzen bei der Berliner Botanischen Tauschanstalt, Leiter Herr OTTO BEHR, Forst (L.), Deutschland. Ein anderer Teil wurde auf unsere Bitte eigens für uns gesammelt und zwar auf Sumatra (Pik von Kerintji) von Herrn G. H. KLOOSTERBOER, auf Java in der Umgebung von Buitenzorg von Herrn A. C. V. VAN BEMMEL, Zoologe am Museum daselbst. Den genannten Herren möchten wir auch an dieser Stelle unseren aufrichtigen Dank darbringen.

Das Herbariummaterial war natürlich vollkommen trocken und z.T. Jahre oder selbst Jahrzehnte alt. Da es aber für die Moosherbarien bestimmt und beim Einsammeln — besonders der an nassen Stellen wachsenden Arten — vielleicht von einem Teil seines Wassers durch Auspressen beraubt worden war, ist die Möglichkeit nicht ausgeschlossen, dass die darin noch anwesenden Assoziationen nur einen Bruchteil ausmachten der im frischen Zustand darin vorhandenen; d.h. aus dem aktuellen Fehlen bestimmter Arten in einer trockenen Probe darf nicht geschlossen werden, dass dieselben in der frischen nicht vorgekommen wären.

Das andere, eigens für uns gesammelte, Material dagegen hatte noch mehr oder weniger seinen normalen Wassergehalt als es in unsere Hände gelangte und dürfte daher im Augenblick der Untersuchung noch dieselben Assoziationen d.h. dieselben Arten in derselben prozentualen Kombination enthalten haben, welche es auch am natürlichen Standort besass.

Unsere Untersuchung beschränkt sich auf die thekamöben Arten, welche grösstenteils in der Form leerer Schalen im Material vorhanden waren. Von einigen Arten wurden auch ausnahmsweise Zysten beobachtet; noch seltener traten im frisch untersuchten Material lebende, aktive Individuen auf, in den Herbariumproben niemals.

Die Arten der Bryales waren soweit es sich um gekauftes Material handelte bestimmt, bei den anderen war das nicht der Fall. Es war dies aber kein Nachteil, weil frühere Untersuchungen uns gelehrt hatten, dass ein Zusammenhang zwischen den Assoziationen der Rhizopoden und den von ihnen bewohnten Moosarten nicht besteht.

Nähere Angaben über die Eigenschaften des Milieus in dem die von den Rhizopoden bewohnten Moose gewachsen waren, standen uns nur in wenigen Fällen und in beschränktem Umfang zu Gebote; daher wurde darauf keine Rücksicht genommen und ist unsere Arbeit nur als eine rein morphologische zu betrachten. Diese Beschränkung war uns aber nicht unwillkommen; wie schon oben gesagt, stehen wir weitgehenden Schlüssen oekologischer Art speziell bei dieser Gruppe, wie man solche bei einigen Autoren finden kann, etwas kritisch gegenüber, auch schon aus diesem Grunde, weil die systematische Natur der „Arten", an welche diese Schlüsse geknüpft werden, unserer Meinung nach in vielen Fällen noch gar nicht sicher genug fundiert ist. Wir neigen immermehr zu der Ansicht, dass eben bei den Süsswasserrhizopoden, über die wir aus eigener, langjähriger Erfahrung einigermaassen urteilen können, eine „Art" nur ein relativ willkührlicher Querschnitt eines mehr oder weniger grossen Formenkreises darstellt, deren Grenzen nach beiden Seiten oft nicht genügend scharf gezogen werden können.

Die Autorennamen sind fortgelassen worden; in der Nomenklatur haben wir uns im allgemeinen der Bearbeitung der Britischen Rhizopoden von CASH, HOPKINSON und WAILES (1905 - '19) angeschlossen; nur für die Gattungen *Nebela* und *Centropyxis* sind die Arbeiten von DEFLANDRE (1936, 1929) mit berücksichtigt.

Wir haben durch Hinzufügung der Zahlen 1 - 6 versucht, die relative Frequenz der einzelnen Arten in jeder Probe anzugeben; 1 bedeutet sehr selten, 6 sehr allgemein. Obgleich diese Angaben durch verschiedene Umstände nur einen bedingten und auch ungleichen Wert haben, können sie doch einigermaassen dazu beitragen, den Grad der Häufigkeit der Art in einer Probe auszudrücken. Sie sind nicht etwa schätzungsweise, mehr oder weniger willkührlich, niedergeschrieben, sondern auf Grund genauer Zählungen aller Individuen in einer Anzahl Präparate nach einer bestimmten Methode abgeleitet.

II. ANALYSEN DER PROBEN.

I. *Rhizogonium spiniforme;* Gedeh, W. Java; gesammelt von Hj. MÖLLER, 1897, untersucht 1938.

Arcella ?artocrea	2	*Phryganella hemisphaerica*	4
Centropyxis aculeata	1	„ *?nidulus*	1
Trigonopyxis arcula	4	*Euglypha* spec.	2
Hyalosphenia ?subflava	1	*Assulina muscorum*	2
Nebela ?collaris	1	„ *seminulum*	1
„ *militaris*	1	*Corythion dubium*	1
„ *tincta*	2	*Trinema complanatum*	1
„ *vas*	1	„ *enchelys*	1

Bemerkungen.

Arcella ?artocrea PENARD.

Schale entweder kreisrund oder breit-elliptisch mit typischer *artocrea*-Struktur; Mundöffnung ebenfalls rund oder elliptisch, mit etwa 20 grossen Poren.

Grösse: die runden Individuen etwa 90, Mundöffnung etwa 20 μ; die elliptischen lang 110 - 120, breit 80 - 85, Mundöffnung lang 33 - 37, breit 17 - 20 μ.

Centropyxis aculeata.

Nur ein einzelnes Exemplar, lang 150, breit 133, Mundöffnung lang und breit 40 μ; 3 Stacheln.

Trigonopyxis arcula.

Eine individuenreiche Population, in jeder Hinsicht typisch.

Grösse: 103 - 140 μ, ein Exemplar 160 μ.

Nebela ?collaris.

Die nur in wenigen Exemplaren vertretene, unter diesem Namen angeführte *Nebela*-Form war vielleicht wesentlich eine *N. tincta* mit *collaris*-Konvergenz; die Lateralporen waren wahrscheinlich wohl immer anwesend, aber nicht immer gut zu beobachten. Farbe gelblich, Struktur wie bei *tincta*.

Grösse: lang etwa 140, breit etwa 110 μ.

Nebela tincta.

Auch von dieser Art wurden nur wenige Exemplare beobachtet, alle soweit ersichtlich den normalen Typus darstellend.

Grösse: lang 83 - 100, breit 57 - 73 μ.

Nebela vas.

Nur ein einziges Exemplar, lang (total) 156, Hals lang 53 μ; breit: Fundus 100, Halsbasis 57, an der Mundöffnung 37 μ.

Phryganella hemisphaerica und **?nidulus.**

Die Art *hemisphaerica* war in typischen Individuen vertreten, Grösse 33 - 63, Mundöffnung 17 - 30 μ. Daneben trat eine grössere Form auf, welche vielleicht zu *nidulus* zu stellen ist; Grösse 73 - 123, Mundöffnung 33 - 53 μ.

II. *Mniodendron divaricatum;* Tjibeureum, Gedeh, W. Java, 1700 m; gesammelt von Hj. MÖLLER, 1897, untersucht 1938.

Arcella ?artocrea	2	*Nebela vas*	1
Centropyxis aculeata	2	„ spec.	1
„ *constricta*	4	*Quadrula scutellata*	3
Trigonopyxis arcula	3	*Phryganella hemisphaerica*	3
Heleopera petricola	2	*Euglypha cristata*	2
„ „ var. *amethystea*	1	„ *?laevis*	2
„ *?picta*	1	„ spec.	2
Nebela ?collaris	3	*Assulina muscorum*	2
„ *?dentistoma*	1	*Trinema lineare*	2
„ *lageniformis*	1	„ *enchelys*	4

B e m e r k u n g e n.

Arcella ?artocrea PENARD.

Obgleich in einigen Punkten abweichend wohl dieselbe Art der Probe I.

Grösse: 80 - 100, Mundöffnung 18 - 20 μ; 10 - 12 ziemlich grosse Poren. Ein elliptisches Exemplar lang 100, breit 77 μ; Mundöffnung lang 23, breit 17 μ.

Trigonopyxis arcula.

Mit Ausnahme eines einzelnen Individuums von 150 μ eine der Grösse nach ziemlich einheitliche Population mit geringer Variationsbreite.

Grösse: 110 - 130 μ.

Centropyxis aculeata.

Schale breit-elliptisch, aufgeblasen, gelblich, chitinös, mit wenigen Xenosomen; Mundöffnung ziemlich klein, deutlich invaginiert; 2 - 4 Stacheln.

Grösse: lang 140 - 160, breit 107 - 113 μ.

Centropyxis constricta.

Eine kleine Form dieser polymorphen „Art".

Grösse: lang etwa 57, breit etwa 47 μ.

Heleopera petricola (mit var. **amethystea).**

Nur wenige, ziemlich typische Individuen dieser Art und ihrer Varietät wurden beobachtet, die letzteren von blassvioletter Farbe, in Grösse nicht vom Typus unterschieden.

Grösse: lang 100 - 150, breit 80 - 107 μ.

Nebela ?collaris.

Schale farblos mit deutlich nebeloider Struktur, ohne Halsporen.

Grösse: lang 100 - 107, breit 67 - 70 μ.

Nebela lageniformis.

Einige Individuen einer normalen Form mit nebeloider Struktur.

Grösse: lang (total) 100 - 153, breit 53 - 93 μ; Hals lang 33 - 40, breit 27 - 47 μ.

Daneben wurde ein einziges abweichendes Exemplar beobachtet mit strohgelber Schale, deren Fundusteil fast kreisrund war, mit kurzem geradem Hals; Totallänge 130 µ, Durchmesser des Fundus 80 µ. Diese Form was uns auch aus Afrika (Kamerun) bekannt.

Nebela vas.

Nur ein einziges Exemplar einer gedrungenen Form.

Grösse: Fundusteil lang 100, breit 100 µ; Hals lang 43, breit an der Basis 57, an der Mundöffnung 37 µ.

Quadrula scutellata (Fig. 64, 65).

Diese interessante Form, von Wailes als *Nebela scutellata* beschrieben, war in diesem Material nicht allzu selten. Einzelne Male fehlten die Nebenplättchen, meistens waren sie aber vorhanden. Die Schale war gewöhnlich ungefähr birnförmig und der Übergang des Fundus- in den Halsteil ein allmählicher; daneben kam aber ebenfalls eine Form vor, bei welcher dieser Übergang sehr plötzlich war und die Schale an dieser Stelle eine deutliche, mehr oder weniger tiefe Einschnürung zeigte. Dadurch bekam die Schale eine gewisse Ähnlichkeit mit derjenigen von *Nebela vas;* aus diesem Grunde meinen wir diese Form als var. *vas* andeuten zu dürfen. Weil sie aber an diesem Fundort durch viele Zwischenformen mit dem Typus verbunden war, ist es nicht angebracht, sie als selbständige Art anzuführen (s.S. 247).

Grösse: Fundus lang 83 - 110, breit 53 - 93 µ; Hals lang 40 - 50, breit an der Basis 40 - 53, an der Mundöffnung 30 - 37 µ.

Trinema enchelys.

Diese Art war in einer grossen Form ziemlich allgemein in der Probe vertreten, in Länge, Breite und Breitenindex der Schale stark variierend. Bei den meisten Schalen war die Struktur gut erhalten und zeigte die bei den grossen Formen dieser Art übliche Zusammensetzung aus nahezu kreisrunden Idiosomen, welche einander mit den Rändern überdeckten; bei einigen Individuen waren auch Xenosomen darunter gemischt und zwar die immer leicht und mit Gewissheit zu erkennenden quadratischen Plättchen von *Quadrula scutellata.*

Grösse: lang 87 - 140, breit 37 - 113 µ.

III. *Trachypus bicolor,* Pangerango, W. Java, 3000 m; gesammelt von Hj. Möller, 1897, untersucht 1938.

Arcella ?artocrea	1	*Quadrula tropica*	2
Centropyxis ?constricta	5	*Phryganella hemisphaerica*	1
Trigonopyxis arcula	1	*Euglypha ?ciliata*	1
Difflugia globulosa	2	*Assulina muscorum*	3
„ *lucida*	2	*Corythion dubium*	2
Nebela bigibbosa	4	*Trinema complanatum*	1
„ *lageniformis*	4	„ *enchelys*	1
„ *tincta*	1	„ *lineare*	1

B e m e r k u n g e n.

Difflugia lucida, s.S. 255.

Nebela bigibbosa, s.S. 236.

Nebela lageniformis (Fig. 29 a und b).

Diese Art war in der Probe in zwei Formen vertreten. Die erste hatte die Gestalt und den Bau der typischen *lageniformis* von PENARD; ihre Grösse variierte von 103 - 113 µ lang, 50 - 73 µ breit; Länge und Breite des Halses lagen zwischen 33 - 50, bzw. 23 - 33 µ. Daneben trat in einigen Exemplaren eine Form auf, welche vielleicht mit der var. *cordiformis* HEINIS identisch ist oder dieser doch sehr nahe steht. DEFLANDRE (1936) meint, dass die Merkmale dieser Form abweichend und fixiert genug sind, um diese zu einer selbständigen Art zu erheben: *Nebela cordiformis* (HEINIS) DEFL. Auch unsere Exemplare hatten in der Seitenansicht die sehr charakteristische Gestalt dieser Varietät; ihre Grösse war von derjenigen des Typus nicht wesentlich verschieden.

Nebela tincta.

Nur zwei Exemplare der flabelluloiden Form dieser Art wurden in dieser Probe gefunden, beide typisch. Länge und Breite des ersten Exemplares 90, bzw. 110, des zweiten 93, bzw. 103 µ; Länge des Halses 5, bzw. 3 µ.

Quadrula tropica, s.S. 248.

IV. *Bryales* div. indeterm.; Gedeh, 2400 m, W. Java; gesammelt von A. C. V. VAN BEMMEL und untersucht 1938.

Arcella spec.	1	*Nebela tincta*	4
Trigonopyxis arcula	5	*Euglypha ciliata*	1
Heleopera spec.	2	*Placocista ?jurassica*	3
Nebela americana	3	*Sphenoderia fissirostris*	2
„ *flabellulum*	5	*Corythion dubium*	1
„ *militaris*	5		

B e m e r k u n g e n.

Nebela americana (= *N. penardiana* DEFL.) (Fig. 16).

Die Schale dieser *Nebela*-Art war immer farblos und mit deutlich nebeloider Struktur. Im Fundusteil waren die Plättchen gross, von breit-elliptischer Form, entweder mit den Rändern aneinander schliessend oder einander überdeckend; im Halsteil waren sie mehr unregelmässig und oft auch weniger deutlich zu unterscheiden. Der Halsteil war verschieden stark entwickelt; bei einigen Individuen verschmälerte sich der Fundus plötzlich beim Übergang in die Halsgegend, bei anderen war dieser Übergang so allmählich, dass die Seitenkanten fast gerade waren. Im Querschnitt war die Schale etwas komprimiert; die grösste Dicke betrug etwa die Hälfte der grössten Breite. Halsporen waren nicht immer deutlich sichtbar, jedoch wohl immer vorhanden.

Grösse: lang 120 - 148, breit 60 - 83 µ.

Nebela militaris.

Eine ziemlich kleine, kurze und breite Form mit meistens sehr deutlicher Struktur und stark konvexer Lippe.

Grösse: lang 60 - 77, breit 37 - 43 μ.

Nebela tincta-flabellulum.

Die individuenreiche Population dieser Doppelart bestand aus einem zahlreicheren *flabellulum*- als *tincta*-Bestandteil, etwa 5 Individuen der ersten auf 2 der zweiten. Die Schalenstruktur der beiden Komponenten war identisch; oft war die Schale fast hyalin, in anderen Fällen mit sehr deutlich nebeloider Struktur, gewöhnlich aus breit-elliptischen Idiosomen bestehend. Farbe etwas gelblich bis fehlend. Halsporen wohl immer vorhanden, in einigen Fällen nicht gut ausgebildet. Hals besonders bei den *flabellulum*-Formen wenig entwickelt, bisweilen fehlend. Zwischenformen der beiden Komponenten sowohl der Grösse als der Struktur nach vorhanden.

Grösse: *tincta*-Form lang 103 - 140, breit 93 - 133 μ.; *flabellulum*-Form lang 90 - 110, breit 100 - 133 μ.

Placocista ?jurassica.

Diese Form, durch den Bau ihres Mundsaumes sicher als Angehörige der Gattung *Placocista* zu erkennen, stimmte unter den beschriebenen Arten am meisten mit *jurassica* überein, wich aber davon ab erstens durch die etwas ansehnlichere Grösse: 80 - 90, statt 70 - 80 μ., zweitens durch die nach der Mundöffnung hin viel stärker verschmälerte Schalenform. Die meisten Schalen waren gestachelt, nicht nur am Rande, sondern auch auf dem flachen Fundusteil, obwohl hier weniger dicht.

Grösse: lang 80 - 90, breit 53 - 60 μ.

V. *Bryales* div. indeterm., Lebak Saät, Gedeh, W. Java, 2400 m; gesammelt von A. C. V. VAN BEMMEL 1938; untersucht 1938.

Arcella ?artocrea	1	*Nebela militaris*	3
Centropyxis ?constricta	1	„ *tincta*	5
Trigonopyxis arcula	6	„ *vas*	1
Heleopera cyclostoma	1	*Phryganella hemisphaerica*	2
„ *petricola*	1	*Euglypha acanthophora*	1
„ *?picta*	1	„ *?ciliata*	2
„ *rosea*	1	*Assulina muscorum*	2
Nebela americana	1	*Sphenoderia ?lenta*	1
„ *?certesi*	1	*Trinema enchelys*	2
„ *dentistoma*	2	„ *lineare*	1

B e m e r k u n g e n.

Centropyxis ?constricta.

Der Form nach erinnerte diese Art einigermaassen an *C. cassis;* die Struktur der Schale war variabel, mehr oder weniger regelmässig, oft derjenigen von

C. aculeata oder *C. aerophila* gleichend, in einigen Fällen aber auch schwach nebeloid, wie etwa bei *Trinema* spec.; der Xenosomenanteil war meistens nur gering.

Grösse: 80 - 87 μ.

Trigonopyxis arcula.

Die Population dieser Art bestand wahrscheinlich aus zwei Grössenklassen. Mundöffnung gewöhnlich spitz dreieckig, bisweilen unregelmässig gelappt oder fast kreisrund.

Grösse: 113 - 180 μ.

Heleopera cyclostoma (Fig. 69 a).

Die sehr sparsamen Schalenfragmente dieser Art brachten wir anfangs zu *Heleopera petricola* var. *amethystea.* Nachdem es uns aber gelungen war, ein tadellos erhaltenes Exemplar aufzufinden, hatten wir Gewissheit, dass es sich um *cyclostoma* handelte. Etwas später wurde ein zweites, ebenfalls vollkommen unbeschädigtes Individuum mit der typischen Farbe und Struktur dieser Art beobachtet. Dieses zweite Individuum war aus mit KOH behandeltem Material; es war auffallend, dass sich die gesättigt violettrote Farbe darin vollkommen unverändert erhalten hatte.

Grösse: lang 183, bzw. 163, breit 167, bzw. 127 μ; das erste Exemplar hatte einen abnormen Breitenindex.

Nebela americana (Fig. 16).

Einige wenige Schalen dieser auch in anderen indischen Proben nicht seltenen Art.

Grösse: lang 116 - 135, breit 62 - 76 μ. Von einem genau gemessenen Individuum war die Dicke in der Mitte des Fundusteiles 40, an der Halsbasis 20, an der Mundöffnung 13 μ.

Nebela dentistoma.

Die Population dieser Art stimmte mit derjenigen der Probe VIII einer nahen Fundstelle vollkommen überein.

Grösse: lang 79 - 103, breit 65 - 90 μ.

Nebela tincta.

Bei einigen Individuen dieser Art näherte sich die Schalenbreite der Länge sehr weit, sodass einigermaassen flabelluloide Formen zustande kamen. Dagegen zeigten einige andere eine gewisse Annäherung an *N. collaris* durch eine Abnahme des Breitenindex und eine schwache Birnform der Schale. Die Struktur war, wie immer bei dieser Art, sehr variabel.

Grösse: lang 82 - 116, breit 57 - 105 μ; drei Individuen der flabelluloiden Form lang 105, 105, 86, breit bzw. 101, 103, 81 μ.

VI. *Bryales* div. indeterm., Gedeh, Java, 2400 m; gesammelt von A. C. V. VAN BEMMEL 1938; untersucht 1938.

Arcella ?artocrea	1	*Nebela militaris*	5
Trigonopyxis arcula	4	„ *tincta*	6
Heleopera spec. 1	2	„ *tubulata*	1
„ spec. 2	1	*Assulina muscorum*	4
Nebela americana	2	„ *?seminulum*	1
„ *dentistoma*	4	*Sphenoderia fissirostris*	1
„ *lageniformis*	2	*Placocista jurassica*	1

Bemerkungen.

Trigonopyxis arcula.

Eine individuenreiche, in jeder Hinsicht einheitliche Population.

Grösse: 113 - 143 μ.

Heleopera spec. 1 und 2.

Keiner dieser beiden *Heleoperae* konnte mit Bestimmtheit zu einer gut umschriebenen Art gebracht werden. Eine derselben (Fig. 10) hatte eine Struktur, welche etwas an diejenige von *Nebela vitraea* erinnerte; die Schale war besetzt mit zahlreichen unregelmässigen, eckigen Xenosomen — namentlich Quarzkörnern —, die besonders an dem Fundusteil sehr dicht angehäuft waren.

Grösse: lang etwa 125, breit etwa 100 μ.

Nebela americana.

Ziemlich selten, aber soweit ersichtlich durch typische Exemplare vertreten.

Grösse: lang 110 - 127, breit 60 - 71 μ.

Nebela dentistoma.

Zahlreich; abgesehen von der variierenden Struktur des Mundsaumes von konstantem Habitus.

Grösse: lang 100 - 110, breit etwa 90 μ.

Nebela militaris.

Einige Individuen dieser Art hatten besonders grosse Schalenplättchen von breit-elliptischer Form mit einer Längsachse von bis 14 μ gross.

Nebela tincta (Fig. 11).

Neben mehr oder weniger normalen Formen waren in die Population dieser Art auch einige zur *flabellulum*- und *collaris*-Form konvergierende Varianten anwesend; bei den ersten war die Breite fast so gross oder selbst noch etwas grösser als die Länge; die anderen hatten eine schmälere, mehr oder weniger birnförmige Schale. Die Struktur war wie fast immer bei dieser Art verschieden: entweder nahezu hyalin, oder deutlich nebeloid mit kleinen, elliptischen Elementen.

Grösse: lang 80 - 116, breit 65 - 108 μ; vier Individuen der flabelluloiden Form lang 97, 105, 90, 118 μ, breit bzw. 105, 108, 92, 117 μ; drei der collarioiden Form lang 150, 150, 143, breit bzw. 117, 120, 133 μ.

Nebela tubulata.

Nur wenige Individuen dieser, in der Form der Schale einer kleinen *N. lageniformis* gleichenden Art (s.S. 244).

Grösse: lang etwa 67, breit etwa 53 µ; Hals lang etwa 37, breit etwa 23 µ.

VII. *Bryales* div. indeterm.; Gedeh, 2400 m, W. Java; gesammelt von A. C. V. van Bemmel 1938; untersucht 1938.

Arcella ?artocrea	1	*Nebela tincta*	4
Trigonopyxis arcula	5	*Phryganella hemisphaerica*	4
Heleopera cyclostoma	1	*Euglypha* spec.	1
„ *rosea*	1	*Assulina muscorum*	2
„ spec. 1	1	„ *seminulum*	1
„ spec. 2	1	*Sphenoderia fissirostris*	2
Nebela ?americana	1	*Placocista ?jurassica*	1
„ *caudata*	1	*Corythion dubium*	1
„ *dentistoma*	1	*Trinema enchelys*	1
„ *militaris*	5	„ *lineare*	2

Bemerkungen.

Arcella ?artocrea Penard.

Die sehr wenigen Individuen dieser Art hatten eine Schale, deren Struktur sehr an die von *artocrea* erinnerte; sie war meistens ziemlich kreisrund, 100 - 110 µ in Durchmesser und etwa 50 µ hoch; die runde Mundöffnung war mit einem Kranz von etwa 10 kleinen Poren umgeben. Abgesehen von der Struktur war eine gewisse Ähnlichkeit mit der Schale von *A. arenaria* nicht zu verkennen.

Heleopera cyclostoma.

Nur ein Individuum dieser Art, lang 160, breit 110 µ.

Die beiden unbestimmbaren *Heleoperae* waren dieselben der Probe VI.

Nebela ?americana.

Nur wenige, etwas von der typischen *americana* divergierenden Individuen. Grösse: lang 120-140, breit 60 - 77 µ.

Nebela caudata.

Im ganzen nur zwei Individuen, lang 83, bzw. 80, breit 63, bzw. 67 µ.

Nebela dentistoma.

Auch diese Art war in dieser Probe selten, der Bau der Schale normal. Die beiden Modifikationen des Mundsaumes: entweder durch die Umrisse der äussersten Plättchen deutlich gezähnt, oder mit einer gewellten, chitinösen, gelblich gefärbten „Lippe" umgeben, welche Penard (1890) schon in seiner ursprünglichen Diagnose unter dem Namen „bourrelet ondulé" beschreibt, waren nebeneinander vorhanden.

Grösse: lang 93 - 107, breit 73 - 93 µ.

Nebela tincta.

Ebenso wie in anderen Proben, z.B. VI, war die Population dieser Art mit flabelluloiden oder collarioiden Formen untermischt.

Sphenoderia fissirostris.

Unter den Individuen dieser Art wurden einige Male sogenannte Doppelschalen beobachtet, d.h. zwei — leere — Schälchen, mit den Mundöffnungen einander anliegend.

Placocista ?jurassica.

Nur ein Individuum, sehr wahrscheinlich zu dieser Art gehörend. Mit Stacheln, auch auf der flachen Schalenseite.

Grösse: lang 73, breit 53 μ.

VIII. *Bryales* div. indeterm., Gedeh, 2400 m, W. Java; gesammelt von A. C. V. VAN BEMMEL 1938; untersucht 1938.

Arcella ?artocrea	3	*Nebela tincta*	4
„ *arenaria*	1	„ *?tubulata*	2
Centropyxis ?constricta	6	„ *vas*	2
Difflugia ?globulosa	1	*Phryganella hemisphaerica*	5
„ *lucida*	1	„ *?nidulus*	1
Trigonopyxis arcula	5	*Euglypha ?compressa*	1
Heleopera petricola		*Assulina muscorum*	4
var. *amethystea*	1	*Sphenoderia fissirostris*	3
„ *rosea*	2	*Placocista ?jurassica*	1
„ spec.	3	*Trinema complanatum*	2
Nebela americana	3	„ *enchelys*	3
„ *dentistoma*	6	„ *lineare*	2
„ *militaris*	4		

Bemerkungen.

Centropyxis ?constricta.

Die unter diesem Namen angedeutete kleine Form hatte eine stark gewölbte Schale mit etwas eingestülpter Mundöffnung, welche, wie bei *Corythion dubium*, oft mit kleinen, runden Plättchen umgeben war. Die Struktur der Schale stimmte überein mit derjenigen der *Centropyxis*-Art aus Probe V.

Grösse: lang 73 - 85, breit 33 - 51 μ.

Trigonopyxis arcula (Fig. 2 - 4).

Wahrscheinlich waren in diesem Material zwei, nicht durch Zwischengrössen verbundene Grössenklassen dieser Art anwesend, die grössere Form auch durch eine rostbraune Farbe der Schale unterschieden. Mundöffnung meistens unregelmässig gelappt.

Grösse: kleinere Form 84 - 113, grössere 132 - 152 μ.

Difflugia ?globulosa.

Die Schale dieser Form war ungefähr kugelrund, die Mundöffnung aber etwas elliptisch und auch mehr oder weniger exzentrisch gestellt. Vielleicht mehr eine *Centropyxis* spec.

Nebela americana.

Nur wenige vollständig erhaltene Schalen dieser Art, dagegen zahlreiche Fragmente. Typisch nebeloide Struktur.

Grosse: lang 130 - 194, breit 73 - 113 μ.

Nebela dentistoma.

Die meisten Individuen dieser Population hatten den Mundsaum in Form der „Lippe" (s.S. 219); einige Male war auch eine schwache Andeutung eines Halses anwesend. Auch die Struktur hatte etwas Besonderes; es hatte den Anschein, alsob die Schalenplättchen einer anderen Art, vielleicht einer *Trinema* spec., entnommen waren, wodurch bisweilen eigentümliche Kombinationen zustande kamen.

Grösse: lang 86 - 95, breit 70 - 92 μ.

Nebela tincta.

Von der Population dieser Art gilt das Gesagte bei den Proben VI und VII.

Nebela vas (Fig. 47 a und b).

Nur wenige, aber vollkommen typische Exemplare.

Grösse: lang 113 - 150, breit 103 - 130 μ.

Heleopera petricola var. **amethystea.**

Neben einer Anzahl Individuen dieser Varietät von normalem Habitus (Grösse: lang 124 - 130, breit 80 - 103 μ) kam ein einziges tief violett-rotes Exemplar vor, lang 180 und breit 130 μ, welches vielleicht eher eine *H. cyclostoma* war.

Heleopera rosea.

Eine nicht gerade zahlreiche, aber typische Population.

Grösse: lang 76 - 87, breit 43 - 68 μ.

IX. *Bryales* div. indeterm., Pik von Kerintji, Sumatra, 1400 m; gesammelt von G. H. KLOOSTERBOER, 1938, untersucht 1938.

Arcella ?artocrea PENARD	2	*Nebela ?collaris*	2
Centropyxis cassis	1	„ *dentistoma*	1
„ *constricta*	2	„ *griseola*	4
„ *?ecornis*	1	„ *lageniformis*	2
Trigonopyxis arcula	6	„ *martiali*	3
Difflugia oviformis	1	„ *militaris*	2
Heleopera petricola var. *amethystea*	2	„ *tubulata*	2
		„ *vas*	3
Hyalosphenia subflava	1	*Quadrula scutellata*	2
Nebela caudata	4	„ *?symmetrica*	1

Quadrula tropica	2	*Assulina muscorum*	1
Phryganella hemisphaerica	5	*Sphenoderia fissirostris*	2
„ *?nidulus*	5	„ *macrolepis*	1
Cryptodifflugia compressa	3	*Trinema complanatum*	4
Euglypha ?ciliata	4	„ *enchelys*	4
„ spec.	1	„ *lineare*	4

Bemerkungen.

Arcella ?artocrea PENARD (Fig. 56).

Die *Arcella*-Art dieser Probe hatte gewöhnlich eine länglich-elliptische, bisweilen mehr runde Form mit nahezu konformer Mundöffnung, welche mit einem Kranz von etwa 20 feinen Poren umstellt war. Die Farbe war schmutzig braungelb, oft mit einem grünlichen Ton, die Struktur nicht sechseckig fazettiert, sondern fein gekornt.

Grösse: lang 110 - 117, breit 73 - 83, hoch etwa 43 μ; Mundöffnung lang 33 - 40, breit 17 - 23 μ.

Centropyxis cassis (Fig. 77).

Nur wenige Exemplare wurden beobachtet. Die Ausbildung der Mundöffnung machte es aber leicht diese Art zu unterscheiden.

Grösse: etwa 84 μ.

Centropyxis ecornis.

Unter diesem Namen führen wir eine in nur wenigen Exemplaren beobachtete Form an mit fast farbloser, etwas gelblicher, chitinöser, fein fazettierter Schale, welche nur wenige Fremdkörper trug. Schale sowie Mundöffnung waren im Umriss fast kreisförmig, letztere nur schwach invaginiert und fast konzentrisch gelegen. Obwohl diese Form in gewissen Merkmalen von der uns von anderen Stellen bekannten *C. ecornis* unterschieden war, möchten wir sie wenigstens vorläufig zu dieser Art stellen.

Grösse: lang 150 - 170, hoch etwa 100 μ; Mundöffnung 40 - 50 μ.

Difflugia oviformis (Fig. 68).

Von dieser durch den Bau des Mundsaumes leicht kenntlichen Art wurde nur ein einziges Exemplar beobachtet. Farbe hell strohgelb; Struktur undeutlich nebeloid mit eckigen, ziemlich groben Maschen, dadurch abweichend von der für diese Art normalen Struktur.

Grösse: lang 83, breit 50 μ.

Heleopera petricola var. **amethystea** (Fig. 74).

Eine ziemlich typische Form dieser Varietät, mit starkem Xenosomenbesatz am Fundus. Farbe blass violett-rötlich.

Grösse: lang 100 - 110, breit 70 - 77 μ.

Hyalosphenia subflava (Fig. 100).

Nur einzelne Exemplare dieser in Grösse und Form sehr variablen Art; in dieser Probe war sie jedoch in beiderlei Hinsicht sehr einheitlich.

Grösse: lang 73 - 87, breit 47 - 53 µ.

Nebela caudata (Fig. 54).

Diese seltene *Nebela*-Art war in der Probe durch eine reiche Population vertreten. Bei manchen Individuen war die nebeloide Struktur der Schale mehr oder weniger deutlich entwickelt; sie zeigte dann ein unregelmässiges Durcheinander von runden und eckigen, farblosen Plättchen. Andere hatten Xenosomen, namentlich Quarzkörnchen und -splitterchen in verschiedener Menge daruntergemischt. Die „caudae", Hörner, bei manchen Schalen alle oder teilweise abgebrochen, variierten in einer Anzahl von 4 bis 6. Die Grösse der Individuen wechselte zwischen den unten angegebenen, ziemlich engen Grenzen; daneben traten vereinzelt grössere Formen auf von etwa 90 µ lang und 70 µ breit und ein gigantisches Exemplar von 120 µ lang und 107 µ breit (s.S. 239).

Grösse: lang 60 - 77, breit 50 - 63 µ.

Nebela ?collaris.

Obwohl mit einiger Reserve bringen wir zu dieser Art eine kleine Anzahl Individuen aus dieser Probe, welche eine farblose, etwas abgeplattete Schale hatten, mit deutlich ausgesprochener nebeloider Struktur, ohne Poren. Im Habitus war diese Form sehr einheitlich, im allgemeinen ebenso in Grösse und besonders in Länge; nur traten sehr vereinzelt sowohl grössere, wie auch kleinere Formen auf.

Grösse (der Mehrzahl) lang 130 - 137, breit 80 - 100 µ; kleinere Formen lang etwa 100, breit etwa 70 µ; grössere Formen lang etwa 170, breit etwa 120 µ.

Nebela griseola (Fig. 51, 52).

Eine ziemlich individuenreiche Population dieser seltenen Art, welche ebenso wie die „verwandte" *N. tenella* innerhalb der Gattung durch Form und Struktur der Schale eine abweichende Stellung einnimmt. Der stark verschmälerte Hals und wulstig umgekrempelte Mundsaum sind mit der im Querschnitt fast genau kreisrunden Form der Schale und der runden Mundöffnung ausreichende Merkmale zur Charakterisierung. Oft war die nebeloide Grundstruktur durch mehr oder weniger reiche Ansammlung von Xenosomen verdeckt.

Grösse: lang 67 - 77, breit 47 - 57 µ.

Nebela lageniformis.

Ziemlich selten, aber in einigen Exemplaren der typischen Form vertreten.

Grösse: lang 110 - 130, breit 57 - 70 µ.

Eine etwa gleich gebaute, aber viel kleinere Form, welche wir anfangs als var. *minor* unterschieden hatten, gehört sehr wahrscheinlich zur *N. tubulata* Brown (s.S. 244).

Nebela martiali (Fig. 37 - 41).

In einer individuenarmen aber einheitlichen, schönen Population vertreten. Schalenfarbe gelblich; Struktur ziemlich deutlich, aber nicht immer typisch nebeloid, da die Elemente oft nicht einzeln zu unterscheiden, sondern zu einer einheitlichen Masse verschmolzen sind, ohne dass jedoch die Grenzen ganz verschwinden. Frontal- und Lateralporen und Halsperlen immer sehr deutlich entwickelt.

Grösse: lang 160 - 180, breit 103 - 123 μ; ein abweichendes Exemplar lang 153, breit 97 μ.

Nebela tubulata.

Diese im Habitus der *N. lageniformis* gleichende und vielleicht, wie WAILES und PENARD (1911) meinen, mit *N. militaris* verwandte Art wurde erst als eine var. *minor* der erstgenannten Art aufgefasst (s.S. 244).

In unserem Material waren *lageniformis* und *tubulata* sehr deutlich geschieden, da Zwischengrössen fehlten.

Grösse: lang 60 - 67, breit 30 - 33 μ; Hals lang 25 - 30, breit 10 - 14 μ.

Nebela vas.

Ebenso wie in anderen Proben war diese Art im Bau und Grösse der Schale nur wenig variabel; nur war bei einigen Individuen die Querfurche am Übergang des Fundus- in den Halsteil weniger ausgesprochen als gewöhnlich und daher der Umriss der Schale an dieser Stelle nur in geringem Maasse unterbrochen.

Grösse: lang 130 - 143, breit 80 - 97 μ.

Quadrula scutellata.

Eine kleine Anzahl schön geformter und gut konservierter Exemplare dieser Art, einige mit Reserveplättchen. Ebenso wie in der Probe II war der Übergang von Fundus- in Halsteil sehr verschieden entwickelt, entweder ganz allmählich oder mit einer mehr oder weniger tiefen Einschnürung, ohne dass aber eine so ausgesprochene Querfurche wie bei *N. vas* ausgebildet war.

Grösse: lang 123 - 153, breit 67 - 80 μ. Von vier genau gemessenen Individuen waren Totallänge a, Fundusbreite b, Halslänge c, Halsbreite an der Basis d und Mundweite e in μ:

a	b	c	d	e
150	77	50	40	33
153	80	47	40	30
133	77	47	43	30
147	77	50	40	30

Quadrula ?symmetrica (Fig. 63).

Neben den beiden anderen *Quadrula*-Formen trat in wenigen Individuen noch eine dritte auf, welche vielleicht die var. *longicollis* TARÁNEK von *Q. symmetrica* darstellte. Die Anordnung der Plättchen war sehr regelmässig; sie maassen etwa 15 μ in Länge und Breite; auffallend war besonders auch der fast

geradlinige Verlauf der Seitenkanten der Schale. Auch die Grösse stimmte gut und unterschied die Form zugleich von *Q. symmetrica* var. *irregularis* Penard. Wenn die Bestimmung richtig ist, würde dieser Fall das einzige Vorkommen einer *Q. symmetrica* in unserem ganzen indischen Material sein.

Grösse: lang 110, breit 47 μ.

Quadrula tropica s.S. 247.

Phryganella ?nidulus.

Neben der gewöhnlich in Moosen reich vertretenen *Phryganella hemisphaerica* enthielt diese Probe eine zweite Form, welche wir als zu derselben Gattung gehörend auffassen möchten, weil sie in Form und Struktur der Schale und in Form und Grössenverhältnis der Mundöffnung vollkommen mit *hemisphaerica* übereinstimmte, sich aber davon konstant durch die Grösse unterschied. Es schien, alsob Zwischengrössen nicht vorhanden waren; wir haben das aber nicht genauer studiert.

Grösse: 63 - 73 μ.; Mundöffnung 33 - 47 μ.

Euglypha spec. (Fig. 8).

Neben einer *Euglypha*-Art, welche wir als *ciliata* deuteten, waren in der Probe einige *Euglypha*-Individuen anwesend, welche durch den Besitz einer Anzahl sonderbarer Anhänge auffielen, wie sie uns bisher nicht bekannt waren. Die Schale war etwa 55 μ lang und 23 μ breit; der Mundsaum wurde von einigen undeutlich gezahnten Plättchen gebildet. Regellos auf der Oberfläche der Schale verteilt standen in einem geraden oder schiefen Winkel auf der Schalenfläche einige gleichmässig dicke, 15 - 20 μ lange, gerade Stäbchen, welche am Ende leicht angeschwollen waren. Sie waren bei allen beobachteten Individuen gleichartig ausgebildet und es schien uns zu, dass sie zur Natur der Schale gehörten.

Cryptodifflugia compressa (Fig. 98, 99).

Anfänglich übersehen, wurde diese Art in späteren Präparaten des Materials nicht selten beobachtet, teils als leere Schalen, teils mit fixiertem Plasmakörper; in der frischen Probe mögen diese wohl lebend vorhanden gewesen sein. Die mässig stark abgeplattete Schale war vollkommen farb- und strukturlos und entsprach ganz solchen, welche wir von europäischen Fundorten schon kannten.

Grösse: lang 17 - 20, breit 14 - 17 μ.

Sphenoderia macrolepis (Fig. 92, 93).

Diese von Leidy aus Amerika zum ersten Mal beschriebene und später für soviel uns bekannt übrigens nur in Europa (Grossbrittannien und Irland) wiedergefundene Art war uns aus eigener Anschauung noch unbekannt. In einem der letzten untersuchten Präparaten des Materials fanden wir erst ein unsicheres, später ein etwas besseres, endlich ein tadellos erhaltenes Exemplar auf; nachdem so unsere Aufmerksamkeit darauf eingestellt war, fanden wir schliesslich noch 5, im ganzen also 8 Individuen, leider nur in Form leerer Schalen; lebende Tiere wurden nicht beobachtet, ebensowenig enzystierte oder solche mit fixiertem

Plasmakörper. Der Bau der Schale stimmte mit den von LEIDY und WAILES und PENARD gegebenen Beschreibungen überein; der Umriss der wenigen, grossen, breit-elliptischen Plättchen war regelmässig gerundet, wie WAILES (1915, Taf. XLIII, Fig. 13) angibt und nicht vieleckig wie in der allerdings sehr schematisch gehaltenen Figur von LEIDY.

Grösse: lang 33 - 40, breit 25 - 28 μ.

Trinema complanatum-enchelys-lineare (Fig. 83 - 91).

Eine individuenreiche und vielgestaltige Population dieses Formenkreises in allen denkbaren Grössen und Grössenverhältnissen zwischen den äussersten Grenzen.

Grösse: lang 20 (*lineare*) — 120 (*enchelys*),
breit 8 „ — 60 μ „

X. *Bryales* div. indeterm., Pik von Kerintji, Sumatra, 1400 m; gesammelt von G. H. KLOOSTERBOER 1938; untersucht 1938.

Arcella ?artocrea PENARD	1	*Nebela militaris*	1
Centropyxis aculeata	1	„ *tubulata*	2
„ *constricta*	2	„ *vas*	1
„ *?minuta*	1	*Quadrula tropica*	2
„ *?orbicularis*	2	„ *plicata*	5
Trigonopyxis arcula	4	*Phryganella hemisphaerica*	5
Heleopera petricola		„ *?nidulus*	4
var. *amethystea*	1	„ spec.	1
„ *cyclostoma*	1	*Euglypha* spec.	3
Nebela americana	1	*Assulina muscorum*	1
„ *?collaris*	1	*Corythion dubium*	1
„ *dentistoma*	1	*Trinema complanatum*	2
„ *lageniformis* a	5	„ *enchelys*	1
„ *lageniformis* b	2	„ *lineare*	4
„ *martiali*	2		

(Ausserdem:
Amoeba terricola, Actinophrys sol, beide lebend).

B e m e r k u n g e n.

Arcella ?artocrea PENARD.

Dieselbe Form wie in der ebenfalls an dieser Fundstelle gesammelten Probe IX.

Centropyxis aculeata.

Nur sehr vereinzelt in einer grossen Form dieser vielgestaltigen Art. Schale chitinös, braungelb mit wenigen Xenosomen; Mundöffnung stark exzentrisch, ziemlich tief invaginiert; Stacheln etwa 5 an der Zahl.

Grösse: lang etwa 160, breit etwa 120; Mundöffnung etwa 33 μ.

Centropyxis constricta (Fig. 79, 80).

Eine sehr kleine Form, zahlreicher als die vorige Art. Farblos, mit vielen Xenosomen. Vielleicht verwandt mit der von DEFLANDRE als *C. cassis* (= *Difflugia cassis* WALLICH) beschriebenen Form.

Grösse: lang etwa 53, breit etwa 33 μ.

Daneben einige grössere, stärker zu *C. cassis* konvergierende Formen (Fig. 79); Grösse bis etwa 80 μ.

Centropyxis ?minuta (Fig. 82).

In nur wenigen Exemplaren war in dieser Probe eine Form vertreten, welche wir provisorisch zur obigen, von DEFLANDRE (1929) aufgestellten Art bringen möchten; vorher war sie von LEIDY und PENARD beobachtet. Mit der von DEFLANDRE gegebenen Diagnose stimmte sie weitgehend überein; ihre Grösse lag an der Maximumgrenze der von ihm gefundenen (35 - 60 μ). Vielleicht sind kleinere Formen in diesem Material übersehen worden.

Grösse: etwa 60, Mundöffnung etwa 17 μ.

Centropyxis ?orbicularis (Fig. 78 a und b).

Diese Art ist immer etwas schwierig zu identifizieren, wenn es sich nicht um musterhafte Beispiele des Typus handelt. Die in dieser Probe gefundenen Individuen waren in zweierlei Hinsicht abweichend vom Typus:

1. Die Mundöffnung war oft stark nach dem Zentrum hin gerückt, sodass die Formen oft an Arten der Gattung *Cyclopyxis* erinnerten.

2. Die Grösse (etwa 75 μ) blieb bedeutend unter der des Typus (100 - 140 μ) zurück.

Wir müssen diese Art also unter Vorbehalt erwähnen.

Heleopera cyclostoma (s.S. 217).

Nur ein einziges Exemplar dieser Art wurde beobachtet, mit den typischen Charakteren derselben.

Grösse: lang 150, breit 110 μ.

Nebela americana (= *N. penardiana* DEFL.) s.S. 236.

Nebela dentistoma.

Von den wenigen beobachteten Individuen dieser Art war die Struktur der Schale auffallend; letztere war nämlich aufgebaut aus nahezu runden oder breitelliptischen Plättchen, welche einander mit den Rändern überdeckten, wodurch ein an die Schale von *N. americana* oder *galeata* erinnerndes Bild zustande kam. Das Merkmal, welchem die Art ihren Namen entlehnt, der eigentümliche gezahnte Mundsaum, war aber immer gut entwickelt.

Grösse: lang 92 - 97, breit 71 - 83 μ.

Nebela lageniformis a und b (Fig. 30 - 32).

Allgemein in dieser Probe war eine gedrungene Form (a) dieser Art mit fast kreisrundem Fundus und davon scharf abgesetztem, kurzem, geradem, nach

der Mundöffnung hin etwas verschmälertem Hals. Wir kannten diese Form schon von Afrika (Kamerun) (s. auch S. 242). Die Schale war meistens farblos, einzelne Male schwach gelb gefärbt, mit deutlich hervortretender nebeloider Struktur.

Grösse: lang 103 - 120, breit 51 - 80 μ.

Genauere Maasse einiger Schalen (a Totallänge, b Fundusbreite, c Halslänge, d Halsbreite an der Basis, e Mundweite in μ):

a	b	c	d	e
110	77	33	33	27
113	77	37	37	27
113	77	37	33	23
107	77	33	33	27
113	80	33	37	30
103	77	30	37	33
117	73	33	33	23
107	73	27	33	30
115	65	37	33	27

Daneben war viel seltener eine Form b von etwa gleicher Totallänge aber geringerer Fundusbreite vertreten; durch letzteres Merkmal und weil Fundus und Hals mehr allmählich ineinander übergingen, hatte diese Form einen schlankeren Umriss.

Grösse: lang 110 - 123, breit 53 - 63 μ.

Hatten wir im Beginn den Eindruck bekommen, dass die beiden Formen ganz scharf, ohne Verbindungsglieder nebeneinander standen, eine Revision des Materials lehrte uns später, dass dies nicht der Fall war und Zwischenformen in jeder Grösse vorhanden waren.

Nebela martiali.

Ziemlich selten, aber durch gut konservierte, typische Exemplare vertreten. Die Schalenstruktur war die übliche; in der chitinösen, gelblich gefärbten Grundmasse waren undeutlich zahlreiche kleine Elemente mit verwaschenem Umriss zu unterscheiden, darunter einige Male quadratische Plättchen, in Form und Grösse übereinstimmend mit den Idiosomen der *Quadrula*-Arten des Materials und zweifelsohne davon herkömmlich. Frontal- und Lateralporen und Halsperlen immer in typischer Ausbildung vorhanden.

Grösse: lang 154 - 180, breit 95 - 130 μ.

Nebela tubulata.

Ursprünglich für eine kleine Form von *N. lageniformis* gehalten, wurde diese *Nebela* spater u.E. besser zu der obengenannten Art gebracht (s.S. 244). Der breit-elliptische Fundus verschmälert sich sehr plötzlich in den fast genau zylindrischen, eng röhrenförmigen Hals.

Grösse: lang 63 - 67, breit 30 - 33 μ; Hals lang etwa 27, breit etwa 13 μ.

Nebela vas.

In einigen normalen Exemplaren nur sehr vereinzelt auftretend.

Grösse: lang 117 - 130, breit 80 - 87 μ.

Quadrula plicata nov. spec., s.S. 248.

Quadrula tropica, s.S. 248.

XI. *Bryales* div. indeterm., Telaga Saät, Poentjak Pass, W. Java, 1400 m; gesammelt von A. C. V. van Bemmel; untersucht 1938.

Arcella spec.	1	*Phryganella ?nidulus*	1
Centropyxis constricta	1	*Euglypha cristata*	1
Trigonopyxis arcula	4	„ spec.	2
Heleopera spec.	1	*Assulina muscorum*	1
Nebela caudata	1	„ *seminulum*	1
„ *certesi*	4	*Sphenoderia fissirostris*	3
„ *dentistoma*	4	„ *?lenta*	1
„ *galeata* f. *minor*	4	*Placocista* a	1
„ *lageniformis*	1	„ b	2
„ *martiali*	2	*Trinema complanatum*	2
„ *militaris*	5	„ *enchelys*	1
„ *tincta*	5	„ *lineare*	3
Phryganella hemisphaerica	2		

Bemerkungen.

Trigonopyxis arcula.

Die Population dieser Art bestand wahrscheinlich aus zwei verschiedenen Grössenklassen, einer von 100 - 120 μ Durchmesser, allgemein; einer anderen von 170 - 190 μ, selten.

Heleopera spec.

Die *Heleopera*-Art dieser Probe war eine grosse, breite, farblose Form mit breitem Munde, etwas gelblich gefärbtem Mundsaum und einem reichen Xenosomenbesatz am Fundus. Am nächsten stünde sie noch der *H. picta* (= *H. sphagni*), war aber doch von der typischen Form dieser Art, soweit uns bekannt, ziemlich verschieden. Einige Individuen zeigten am Fundus die gleiche eigentümliche nebeloide Struktur, welche wir weiter unten bei *Nebela certesi* u.A. erwähnen.

Grösse: lang 113 - 130, breit 93 - 110 μ; Mundöffnung weit 60 - 70 μ.

Nebela caudata (Fig. 55).

Nur wenige, aber typische Exemplare, einige mit deutlich nebeloider Struktur aus breit-elliptischen Plättchen. Dornen schlank.

Grösse: lang 67 - 77, breit 50 - 60 μ.

Nebela certesi (Fig. 42, 43).

Eine individuenreiche Population dieser seltenen, südlichen Art. Die unterscheidenden Merkmale: Form und Grösse der Schale, wenig entwickelte Frontal- und Lateralporen, Längsfurche und Perlen am Halsteil, immer vorhanden. Die Halsfurche variierte in Breite ziemlich stark. Die Schale hatte stets eine deutlich nebeloide Struktur mit gewöhnlich am Fundus sehr grossen, nach dem Hals hin schnell kleiner werdenden breit-elliptischen Plättchen. Entweder waren am Fundus nur diese sehr grossen Elemente anwesend, oder es mischten sich mehr oder weniger zahlreich viel kleinere darunter. Die Figuren 44 und 45 stellen zum Vergleich zwei Exemplare dieser Art aus Neuseeland, bzw. Feuerland dar.

Grösse: lang 100 - 140, breit 60 - 77 μ.; Dicke eines mittelgrossen Exemplares am Fundus 40, am Hals 13, an der Mundöffnung 17 μ.

Nebela galeata f. **minor** s.S. 241.

Nebela martiali.

Selten, aber einige gut konservierte Exemplare. Einzelne darunter mit grossem, kreisrundem Fundus und sehr kurzem Hals. Ein abweichend gebautes Individuum zeigte eine Struktur aus stark hervortretenden elliptischen Plättchen und — vielleicht als Folge davon — einen deutlich gewellten Schalenumriss. Frontal- und Lateralporen immer vorhanden.

Grösse: lang 160 - 173, breit 100 - 127 μ.

Nebela militaris.

In der reichen, typischen Population dieser Art wurde mehr als ein halbes Jahr nach dem Einsammeln ein lebendes, aktives Individuum angetroffen. Auch in anderen Proben fanden wir gelegentlich lebende Individuen der einen oder anderen Art (*Arcella, Cryptodifflugia*).

Nebela tincta.

Eine sehr reiche Population des *N. tincta*-Formenkreises, wie sie auch an anderen Orten angetroffen wurde. Alle möglichen Konvergenzen zu *collaris*- und *flabellulum*-artige Formen waren vertreten. Lateralporen stets vorhanden. Schale öfters fast hyalin, bisweilen mit nebeloider Struktur, in einigen Fällen wie bei *N. certesi* (s. oben); farblos oder mehroder weniger gelblich gefärbt.

Grösse: lang 87 - 127, breit 90 - 123 μ.

Euglypha cristata.

Im ganzen nur 2 Individuen mit typisch ausgebildeter crista.

Grösse: lang 40 bzw. 33, breit 10 bzw. 11 μ.

Sphenoderia fissirostris und **?lenta** (Fig. 95, 96).

Von der erstgenannten Art einige augenscheinlich typische Individuen.

Grösse: lang 37 - 40, breit 23 - 25 μ.

Dazwischen traten einige andere *Sphenoderia*-Formen auf, grösser, mehr breit-elliptisch und mit breiteren Plättchen; diese zeigten eine gewisse Annähe-

rung an *S. lenta.* Vollkommen normale Exemplare der letztgenannten Art wurden aber nicht beobachtet.

Grösse der abweichenden Form: lang 53 - 70, breit 33 - 37 μ.

Placocista a und b (Fig. 9, 10; s. auch S. 215).

Diese Probe enthielt zwei Formen der an der Struktur des Mundsaumes leicht kenntlichen Gattung *Placocista;* Zwischenformen wurden nicht beobachtet. Sie unterschieden sich wesentlich durch die Grösse und auch dadurch, dass die Form a nur randständige Stacheln besass, während bei der Form b die Schale auch auf der flachen Seite mit Stacheln besetzt war, oft bis in der unmittelbaren Nähe des Mundes. Unter einigem Vorbehalt könnte die Form a als eine *P. spinosa* aufgefasst, die Form b dagegen der *P. jurassica* zugerechnet werden oder dieser doch sehr nahestehen.

Grösse: Form a lang 123 - 130, breit 80 - 90 μ;
„ b lang 70 - 83, breit 53 - 60 μ.

XII. *Bryales* div. indeterm., Telaga Saät, Poentjak Pass, W. Java, 1400 m; gesammelt von A. C. V. VAN BEMMEL 1938; untersucht 1938.

Arcella spec.	1	*Euglypha ?ciliata*	2
Centropyxis constricta	2	„ *?laevis*	1
Trigonopyxis arcula	4	*Assulina muscorum*	2
Nebela tincta	2	*Corythion dubium*	1
Phryganella hemisphaerica	3	*Trinema complanatum*	1
Cryptodifflugia compressa	4	„ *lineare*	2

Bemerkungen.

Trigonopyxis arcula.

Eine reiche, in Schalenform, -struktur und -grösse einförmige Population.

Grösse: 110 - 130 μ.

Nebela tincta.

In Gegensatz zu den Proben VI, VII und XI war hier nur die typische *tincta*-Form anwesend, ohne *collaris*- oder *flabellulum*-Konvergenzen. Lateralporen deutlich entwickelt; Struktur schwach ausgesprochen nebeloid.

Grösse: lang etwa 70, breit etwa 57, dick etwa 33 μ.

Cryptodifflugia compressa (s. auch S. 225).

Zahlreich, in augenscheinlich lebenden Individuen, aktive wurden aber nicht beobachtet. Der Bau der farblosen, hyalinen, ziemlich stark komprimierten Schale war der übliche; nur kam es uns vor, dass die Mundöffnung weniger schmal, also mehr breit-elliptisch war als sonst. Oft wurden gepaarte und in einigen Fällen selbst dreifache Individuen beobachtet, niemals dagegen die von PENARD erwähnten und auch von uns früher beobachteten Doppelzysten.

Grösse: lang 17 - 20, breit 13 - 17 μ.

XIII. *Bryales* div. indeterm., Tjibodas, W. Java, 1400 m; gesammelt von A. C. V. VAN BEMMEL 1938; untersucht 1938.

Arcella spec.	2	*Quadrula scutellata*	3
Centropyxis constricta	3	*Phryganella hemisphaerica*	6
„ *discoides*	1	„ *?nidulus*	1
Trigonopyxis arcula	2	*Euglypha cristata*	1
Heleopera cyclostoma	2	„ *?rotunda*	1
„ *petricola*	2	„ spec.	2
„ spec.	2	*Assulina muscorum*	3
Nebela dentistoma	1	*Trinema complanatum*	2
„ *lageniformis*	4	„ *enchelys*	4
„ *vas*	4	„ *lineare*	4

Bemerkungen.

Trigonopyxis arcula.

Einförmige, individuenarme Population dieser Art.

Grösse: 160 - 170 μ.

Heleopera cyclostoma (Fig. 69b, 73).

Nicht zahlreich, aber sehr schöne, typische Exemplare.

Grösse: lang 135 - 173, breit 95 - 117 μ.

Heleopera petricola (Fig. 71).

Die Individuen dieser Art waren zum Teil farblos, zum teil sehr blass violettfarben, der Mundsaum gewöhnlich deutlich gelb. Die Struktur der Schale war normal; nur wurden bei einem Teil der Individuen am Fundus statt des gewöhnlichen Quarzkörnchenbesatzes die eigentümlichen dornartigen Fortsätze beobachtet, welche PENARD (1890) für *H. picta* angibt, wir aber bisher niemals bei einer *Heleopera*-Art gesehen hatten. Es sind vielleicht sehr schmale, senkrecht zur Schalenoberfläche gestellte Plättchen.

Grösse: lang 111 - 150, breit 77 - 100 μ.

Heleopera spec. (Fig. 72).

Neben den beiden genannten Arten dieser Gattung wurde noch eine dritte beobachtet, welche im allgemeinen mit *petricola* übereinstimmte, sich aber davon unterschied durch die etwas geringere Grösse und besonders durch die Struktur der farblosen Schale. Diese war nämlich bedeckt mit sehr breit-elliptischen, oft fast kreisrunden Plättchen, welche mit den Rändern übereinander lagen und nach der Mundseite hin in Grösse abnahmen. Xenosomen fehlten gewöhnlich auch am Fundus; der Mundsaum wurde von zwei struktur- und farblosen Lippen gebildet.

Grösse: lang 93 - 103, breit 60 - 90 μ, einzelne Exemplare bis 140 μ lang.

Nebela lageniformis (Fig. 30 - 32).

Neben den mehr normalen Formen dieser Art kamen vereinzelt andere vor, bei denen der Übergang von Fundus in Hals sehr stetig war und welche sich dadurch der Form *wailesi* DEFL. näherten; die Grösse war aber normal.

Grösse: lang 107 - 143, breit 53 - 70 μ.

Nebela vas (Fig. 46 - 49).

Eine vollkommen typische Population dieser Art, nur in Länge, Breite und Breitenindex der Schale variierend.

Grösse: lang 130 - 153, breit 90 - 110 μ.

Quadrula scutellata (Fig. 66).

Bei sämtlichen Individuen dieser Art war der Halsteil von dem Fundus durch eine plötzliche Verschmälerung, welche oft die Form einer Ringfurche annahm, so deutlich abgesetzt, dass der Habitus der Schale einigermaassen an denjenigen von *N. vas* erinnerte; die Trennung der beiden Teile war aber niemals so vollkommen wie bei der letztgenannten Art. Die sehr typischen Nebenplättchen, welche WAILES bei den amerikanischen Individuen der Art beschreibt, waren hier immer in reicher Entwicklung anwesend.

Grösse: lang 123 - 150, breit 67 - 93 μ.

Euglypha ?rotunda, s.S. 235.

Trinema complanatum-enchelys-lineare (Fig. 83 - 91).

Die drei „Arten" dieser Gattung waren sämtlich in dieser Probe vertreten, die erstere selten, die beiden anderen allgemein. Unter den *enchelys*-Individuen kamen wahre Riesen vor, wie wir solche schon aus Europa kannten.

Grösse: *enchelys* lang 70 - 140, breit 33 - 100 μ; die beiden anderen Arten kleiner, herab bis zu 27 μ lang und 16 μ breit.

XIV. *Bryales* div. indeterm. I-IV, Poentjak-Pass bei Buitenzorg, 1400 m, W. Java; gesammelt von A. C. V. VAN BEMMEL 1939; untersucht 1939.

Arcella ?artocrea	II	*Nebela tincta*	I-IV
Centropyxis ?ecornis	II, III	„ *tubulata*	II
Bullinula indica	IV	„ *?vitraea*	II
Trigonopyxis arcula	I-IV	*Phryganella hemisphaerica*	I-IV
Difflugia lobostoma	III	*Euglypha ?compressa*	I
„ spec.	II	„ *?rotunda*	I, II
Heleopera ?petricola	II, IV	*Assulina muscorum*	I-IV
„ *rosea*	II	*Sphenoderia fissirostris*	I, III
„ spec.	I, IV	„ *lenta*	IV
Hyalosphenia subflava	I-IV	„ *macrolepis*	II
Nebela caudata	I-III	*Corythion dubium*	IV
„ *griseola*	III	*Trinema complanatum*	I-III
„ *lageniformis*	II, III	„ *enchelys*	I, III
„ *militaris*	I-IV	„ *lineare*	I-IV

B e m e r k u n g e n.

Die Liste bezieht sich auf vier Moosproben, welche nahe beieinander gesammelt wurden; diese sind mit I, II, III und IV angeben und die Frequenzangaben fortgelassen worden.

Arcella ?artocrea.

Nur wenige Exemplare in II. Schale elliptisch, etwa 110 µ lang und 80 µ breit; Mundöffnung ebenfalls elliptisch, etwa 36 µ lang und 15 µ breit, umgeben von einer Anzahl undeutliche Poren.

Centropyxis ?ecornis.

Die gleiche Form von Probe IX (s.S. 222).

Bullinula indica (1 a und b).

Es ist bemerkensswert, dass diese in Moosen der ganzen Welt gewöhnlich vorkommende und oft massenhaft auftretende Art in diesen indischen Proben so äusserst selten war. Wir fanden sie nämlich nur in einer einzigen Probe: Poentjak IV und nur in einem einzigen, allerdings vollkommen typischen Individuum, lang 183 µ, breit 173 µ.

Heleopera rosea.

Die nur wenigen in II beobachteten Individuen hatten die typische Farbe dieser Art, während die Form der Schale etwas gedrungener war als bei den uns schon bekannten Formen.

Grösse: lang etwa 95, breit etwa 81 µ.

Heleopera spec. (Fig. 75 a, b).

In IV trat sehr zahlreich eine *Heleopera* auf, welche sich von allen uns bekannten Arten durch einige sehr charakteristische Merkmale unterschied. Die Farbe war ein leicht gelbliches Braun, etwa so wie bei *H. picta;* die meistens sehr ausgesprochene Struktur zeigte elliptische oder fast runde Plättchen, eine netzförmige Figur bildend wie bei einer *Nebela,* nur viel verwaschener. Der Mundsaum war relativ breit und strukturlos, Xenosomen nur in geringer Zahl, aber niemals fehlend; die Mundspalte von der Seite gesehen nicht scharf eingeschnitten, sondern rund ausgebogen, mit dicken Lippen. Alle diese Merkmale zusammengenommen deuten auf eine kleine, schlanke *H. petricola* hin, aber mit der Farbe von *H. picta* und abweichender Mundbildung.

Grösse: lang 62 - 70, breit 40 - 49 µ.

Nebela caudata (Fig. 55).

Zahlreich in I, selten in II und III. Struktur in einigen Fällen sehr schön nebeloid, in anderen weniger ausgesprochen. Mundsaum mehr oder weniger deutlich gewellt oder gezahnt, erinnerend an denjenigen von *N. dentistoma;* 3 - 5 Stacheln.

Grösse: lang 117 - 130, breit 60 - 70 µ; Hals lang 40 - 50, breit 27 - 33 µ.

Nebela lageniformis.

Nur in II und III einige wenige, aber typische Individuen.

Grösse: lang 117 - 130, breit 60 - 70 μ; Hals lang 40 - 50, breit 27 - 33 μ.

Nebela militaris (Fig. 21 - 23).

Diese allgemein auftretende und gewöhnlich gut charakterisierte Art war in sämtlichen vier Proben anwesend. Bei einigen waren Lateralporen deutlich entwickelt. In der Grösse überragten die typischen Formen der Population etwas die schon früher beobachteten Maasse; daneben kamen abweichende Formen und Grössen vor.

Grösse (der normalen Population): lang 62 - 81, breit 30 - 51 μ.

Von den abweichenden Formen erwähnen wir:

1. In I eine grössere als der Typus (bis 115 μ lang und 60 μ breit), mit breiterer Mundöffnung und etwas birnförmiger Schale.

2. In III zahlreich eine Form, welche in der Struktur und dem Bau der Mundöffnung zwar mit *militaris* übereinstimmt, jedoch durch die schärfere Scheidung von Fundus- und Halsteil an *lageniformis* erinnert; der Fundus ist hier auch etwas breiter und runder als bei dem Typus. Derartige Formen erwähnen auch WAILES und PENARD (1911).

Nebela tubulata (Fig. 24 - 28).

In II wurden einige Exemplare einer Form angetroffen, welche auch von DEFLANDRE (1936) beobachtet und von ihm zu *N. tubulata* gebracht wurde (l.c. Taf. XXII, Fig. 10 und 11).

Grösse: lang 62 - 67, breit 33 - 35 μ.

Nebela tincta.

In allen vier Proben vorhanden. Meistens einheitlich von Habitus und Grösse. Collarioide und flabelluloide Konvergenzen selten. Lateralporen bisweilen sehr undeutlich, vielleicht fehlend. Mundöffnung in den meisten Fällen von einem kurzen, aufrechtstehenden strukturlosen Rande umgeben.

Grösse: lang 95 - 108, breit 70 - 81 μ.

Euglypha ?compressa.

Eine stark zusammengedrückte *Euglypha*-Form mit gepaarten Stacheln, in Bau, Form und Grösse der Schale mit *compressa* übereinstimmend, aber mit abweichend gebildeten Mundplättchen; diese hatten nämlich nicht die drei grossen Zähne, welche für *compressa* charakteristisch sein sollen, sondern nur eine sich über die ganze Oberfläche des Plättchens ausstreckende Verdickung.

Grösse: lang 90 - 93, breit 63 - 70 μ.

Euglypha ?rotunda (Fig. 5).

Unter den übrigen untereinander stark abweichenden Formen dieser Gattung traten vereinzelt einige auf, welche der von WAILES und PENARD (1911) beschriebenen *E. rotunda* sehr ähnlich, wenn nicht identisch mit derselben waren; nur die Grösse war ansehnlicher.

Grösse: lang 70 - 90, breit 38 - 43 μ.

III. DIE NEBELA-ARTEN DES MATERIALES.

1. **Nebela americana** (= *N. penardiana* DEFL.) (Fig. 16).

Mehrere Materialproben lieferten diese Art in ziemlich grosser Individuenzahl. Die Beobachtungen waren in Übereinstimmung mit den Resultaten an früherem Material. Auch hier zeigte sich eine weitgehende Verschiedenheit in der Schalenbreite und der Ausbildung des Halsteiles der Schale. Mehrmals war die Anwesenheit zweier seitlicher Schalenporen festzustellen.

Weil die Schalenform eine weit grössere Verschiedenheit vorführen kann als die Diagnose PENARDS für *N. americana* angibt und wahrscheinlich die ursprüngliche Beschreibung TARÁNEKS sich nur auf eine sehr spezielle Form bezieht — wenn die Zusammengehörigkeit mit PENARDS Form nicht ganz fraglich ist —, so ist der für diese Art von DEFLANDRE vorgeschlagene Name N. *penardiana* vielleicht vorzuziehen.

Die beobachteten Dimensionen (Länge 110 - 194 μ) sind übereinstimmend mit denen aus europäischem Material (113 - 178 μ). Durch ihre Grösse war die Art auch in dem indischen Material zu unterscheiden von *N. galeata* f. *minor,* mit welcher *N. americana* in der Struktur der Schale eine grosse Ähnlichkeit hat.

2. **Nebela bigibbosa** (Fig. 33 - 36).

Diese *Nebela*-Art ist gekennzeichnet durch den Besitz einer Pore auf jeder der Breitseiten der Schale, nahezu dort wo der Fundus sich zu dem Halsteil verschmälert (Frontalpore). Jede Pore verlängert sich zu einem Kanal, welches meistens die ganze Dicke der Schale durchquert und auf der anderen Breitseite ausmündet. Solche Porenkanäle besitzen auch die Schalen einiger anderen *Nebela*-Arten (*martiali, certesi, murrayi*), welche, soweit bekannt, nur auf der südlichen Hemisphäre vorkommen, während *N. bigibbosa* bisher nur auf der nördlichen Hemisphäre beobachtet wurde.

Sie wurde 1890 von PENARD in Moosen bei Wiesbaden entdeckt und kurz aber genügend deutlich beschrieben. Später wurde sie von ihm gefunden auf Spitsbergen (1902), bei Morgins (Wallis, Schweiz, 1903) und bei Voirons (Hoch-Savoyen), ferner ausserhalb Europa bei Vancouver und Victoria (Canada, 1907). Derselbe Autor und WAILES erwähnen die Art dann (1911) für Irland, während letztgenannter sie (1919) an verschiedenen Stellen in Grossbrittannien angibt. Auch andere Schriftsteller erwähnen sie noch, offenbar aber aus zweiter Hand und ohne sie gesehen zu haben. DEFLANDRE (1936) nennt sie eine seltene Art, welche bisher nur in Deutschland und Grossbrittannien gefunden wurde; das ist aber, wie wir sahen, unrichtig.

In unserem Material (Probe III vom Pangerango, Java) war *Nebela bigibbosa* in einer ziemlich grosse Zahl von Individuen vertreten; wir können darüber folgendes mitteilen.

Die Grösse der Schale wird von PENARD (1890) angegeben als 140 - 160 μ lang und 100 - 110 μ breit; WAILES und PENARD (1911) geben an lang 135 - 170, breit 87 - 110, dick 50 - 55, Mund 34 - 45 μ; WAILES (1919) und DEFLANDRE (1936)

wiederholen diese Angaben. Bei unseren Exemplaren variierte die Länge von 130 - 170, die Breite von 83 - 123 μ; die Länge stimmte also mit den früheren Angaben überein, während die Breite im Maximum eine ansehnlich höhere Zahl aufwies. Ein sich in unserem Besitz befindendes Präparat aus dem Penard'schem Material von Voirons enthält 8 Exemplare, deren Länge variiert von 143 - 157, die Breite von 87 - 97 μ, während das Etikett die Aufschrift trägt: „petite variété".

Während die Form der Schale, der Bau des Mundes und der Frontalporen unserer Exemplare im allgemeinen übereinstimmten mit der Diagnose von Penard, sind zwei abweichende Merkmale zu verzeichnen. Erstens konnten wir nicht mit Bestimmtheit das Bestehen zweier Lateralporen feststellen welche Penard — und auch Wailes — als solche beschreiben und auch abbilden. Einige Male meinten wir zwar etwas derartiges zu beobachten, aber viel weniger deutlich als z.B. bei *Nebela tincta* und anderen *Nebela*-Arten. Zum Teil war das vielleicht eine Folge der oft sehr rauhen und unebenen Schalenkontur (s. unten), wodurch eventuell vorhandene Poren sich viel weniger deutlich abzeichnen müssten als bei einem glatten Schalenumriss. Aber selbst wenn dieser Umriss sich als eine feine, scharf gezeichnete Linie ausnahm, war die Anwesenheit der Poren nicht ganz sicher.

Zweitens fanden wir die Struktur der Schale ziemlich abweichend. Nach Penard und Wailes besitzt dieselbe den üblichen nebeloiden Bau: runde und elliptische Plättchen, welche sich mit den Rändern mehr oder weniger decken. Auch bei unseren Exemplaren war das bisweilen der Fall; bei anderen dagegen mischten sich unter die Idiosomen kleinere oder grössere Mengen Xenosomen: Quarzkörner, -plättchen und -schüppchen, oft in so grosser Menge und so dicht zusammengehäuft, dass die Grundstruktur der Schale dadurch mehr oder weniger gründlich maskiert wurde. Abgesehen von der Form glich solch eine Schale nicht selten mehr derjenigen einer *Difflugia* als einer *Nebela*. Wir erinnern uns nicht, eine so starke Ergänzung, bzw. Substitution der idiosomatischen Schalenelemente durch xenosomatisches Material bei irgend einer anderen *Nebela*-Art je beobachtet zu haben. Zwischen den beiden Äussersten: praktisch keinen und ausserordentlich vielen Xenosomen, waren alle möglichen Übergänge vorhanden. Wenn die Xenosomenbedeckung sehr dicht war, waren auch die Frontalporen kaum sichtbar; dies kann auch die Ursache davon gewesen sein, dass vielleicht vorhandene Seitenporen sich ebenfalls der Beobachtung entzogen, sodass auch aus diesem Grund das Vorkommen dieser Poren von uns nicht in Abrede gestellt werden kann.

3. **Nebela caudata** (Fig. 53 - 55).

Diese uns zuvor nur aus der Literatur bekannte, nach bisherigen Erfahrungen zu urteilen weit verbreitete, aber seltene und in Europa wahrscheinlich fehlende Art trat, wir in den Analysen schon erwähnt wurde, in zwei unserer Proben auf, nämlich vom Poentjak-Pass bei Buitenzorg, Java, und vom Pik von Kerintji, Sumatra, beide Male in zahlreichen Exemplaren. Sie wurde von

Leidy in Nordamerika (1876, '79) entdeckt und dort von ihm an zwei Stellen angegeben, jedesmal in *Sphagnum*. Mit einer Ausnahme sind alle späteren Angaben dieser Art von aussereuropäischen Fundorten: Canada, Peru, Brasilien, Bolivia, Australien, Neuseeland, Polynesien, die meisten auch von der südlichen Halbkugel. Der einzige europäische Angabe, aber von ihm mit einem Fragezeichen versehen, war von Penard (1905); es betraf eine Materialprobe vom Loch Ness in Schottland, wo sie später auch angegeben wird von Murray (1905) als beobachtet von Scourfield. Es scheint, dass nur Wailes (1912) lebende, aktive Individuen beobachtet hat; sonst wurden nur Zysten oder leere Schalen gefunden. Auch Leidy, welcher im ganzen nur ein halbes Dutzend Exemplare sah, sagt, dass keines davon im aktiven Zustand verkehrte.

Das Motiv, diese vom Typus jedenfalls durch die Schalenanhänge abweichende Art zur Gattung *Nebela* zu rechnen, ist eigentlich nur die Struktur der Schale. Tatsächlich fanden wir dieselbe in Übereinstimmung mit Leidy oft typisch nebeloid, mit grösseren oder kleineren, kreisrunden oder elliptischen Plättchen; in anderen Fällen, wie ebenso von Leidy beobachtet, war die Struktur sehr undeutlich und verwaschen; endlich sahen wir einige Individuen, welche zwischen den Idiosomen mehr oder weniger reichlich Xenosomen, nämlich Quarzkörner, hatten. Die Schale war immer farblos, in der Vorderansicht breitelliptisch mit gerade abgeschnittenem Mundrand und mässig zusammengedrückt.

Das am meisten auffallende Merkmal der Schale bilden die Anhänge, welche 3 - 6, meistens 4 an der Zahl, auf dem schmalen Fundusrand eingepflanzt sind; auf sie bezieht sich der Artname *caudata*. Dieser Name ist aber nicht sehr glücklich gewählt, da „cauda" Schwanz heisst und es wohl nicht Tiere mit vier Schwänzen gibt. Besser wäre also *aculeata* d.h. gestachelt, vgl. z.B. *Centropyxis aculeata*, mit deren Dornen die Anhänge von *Nebela caudata* tatsächlich sehr weit übereinstimmen. Sie scheinen aus einer chitinösen Substanz, wie diejenige der Schale, zu bestehen, sind aber auch oft mit kleinen idio- oder xenosomatischen Elementen bedeckt. Sie sind hohl, an der Spitze wohl offen, meistens hakenförmig gekrümmt, zylindrisch, oft etwas kolbenförmig. In unserem Material fehlten sie nicht selten oder waren mehr oder weniger reduziert, was wir der Art und Weise des Sammelns und Aufbewahrens zuschrieben. Penard (1911) dagegen fasst solche auch in seinem Material vorhandene Individuen als natürliche auf und konstatiert so eine starke Variabilität in der Entwicklung der Anhänge, welche in der einen Richtung so weit gehen kann, dass sie vollkommen fehlen und die Schale uns etwas ganz anderes vortäuscht als sie in Wirklichkeit ist und zwar eine Varietät von *Nebela dentistoma*.

Die Grösse von *Nebela caudata* wird wie folgt angegeben (in μ):

Leidy	lang	80,	breit	60
Wailes	„	80 - 84,	„	60 - 68
Deflandre	„	76 - 90,	„	56 - 70
Heinis	„	74,	„	—
Playfair	„	76,	„	58

Wir fanden die folgenden Maasse:

Poentjak-Pass	lang 62 - 77	breit 50 - 67
Pik von Kerintji	„ 60 - 93	„ 50 - 77,

während ein Riesenexemplar des letzten Fundortes 120 µ lang und 107 µ breit war [1]). Wie man sieht, zeigt unser Material weitaus die grösste Variation, vielleicht wohl die Folge der grösseren Reichhaltigkeit als im Material der anderen Beobachter.

4. **Nebela certesi** (Fig. 42 - 45).

In den charakteristischen Merkmalen ist diese Art *N. martiali* fast gleich und könnte für eine kleine Nebenform der letztgenannten gehalten werden. Den auffallendsten Unterschied bildet die Längsfurche in der Mitte des Halses. Oft ist diese Furche ganz schmal und sieht man ihr nur als einen doppeltkonturierten Strich; manchmal ist sie aber etwas breiter und bildet eine Rinne, welche nach dem Fundus hin ausklingt.

Neben dieser Halsfurche sind, wie auch bei *N. martiali,* immer einige glänzenden „Perlen" zu beobachten. Ebenso besitzt die Schale laterale Poren und beim Übergang vom Hals zum Fundus ein Paar mehr oder weniger gut ausgebildeter Frontalporen.

Eine Kamm- oder „galea"-Bildung, wie bei *N. martiali,* ist bei *N. certesi* nicht oder kaum zu bemerken.

Meistens ist die Struktur der Schale typisch nebeloid und schärfer ausgeprägt als bei *N. martiali.*

Die Grösse der Schale ist immer bedeutend geringer als bei der letztgenannten Art.

Wenn volkommen typische Exemplare vorliegen, ist der Unterschied beider Arten deutlich; wenn aber die eigentümlichen Züge etwas unscharf ausgebildet sind, können *N. certesi* und *martiali* eine grosse Ähnlichkeit aufweisen.

Grösse: lang 100 - 140, breit 60 - 77 µ.

5. **Nebela dentistoma** (inkl. **N. vitraea** und **crenulata)** (Fig. 17 - 20).

In zahlreichen Materialproben europäischen Ursprungs haben wir Populationen dieses Formenkreises beobachten können und daraus hat sich ergeben, dass es sich hier um ein buntes Durcheinander handelt, bei dem es ohne eine gewisse Willkür nicht möglich ist, eine Aufsplitterung in wohlumschriebene Sonderarten durchzuführen. Nur ausnahmsweise trifft man hier oder da eine Population, die sich einigermaassen einheitlich benimmt und dann als *N. dentistoma* oder *vitraea* zu benennen wäre. Diese beiden Arten sind aber nur als Äussersten eines sehr variablen Formenkreises aufzufassen. Eine scharfe Trennung haben wir also aufgeben müssen und daher auch den ursprünglichen Namen *Nebela dentistoma* bevorzugt.

[1]) NACHTRAG WÄHREND DER KORREKTUR. — In fosillem Material aus einem Moor in Ostsumatra fanden wir später in einigen Individuen eine derartige, der *N. caudata* nahestehende Riesenform, lang 140 - 160, breit etwa 120 µ, welche vielleicht zu *Nebela spicata* WAILES gebracht werden konnte.

Die Variabilität dieser Formen betrifft hauptsächlich die folgenden Merkmale:

1. Die Schalenform. Diese kann eirund, breit-elliptisch oder birnförmig sein. In einigen Fällen war eine wenig ausgesprochene Halsbildung zu bemerken. Immer ist die Schale mehr oder weniger zusammengedrückt, im Durchschnitt ellipsförmig.

2. Die Struktur der Schale. Vielleicht ist dies das variabelste Merkmal. Als Bauelemente können eckige, stabförmige, abgerundete oder fast kreisrunde Quarzplättchen verwendet sein, aber auch mehr kompakte, kornförmige, oft stark lichtbrechende Quarzpartikeln, zwischen welche einige unverkennbare Idiosomen eingestreut sein können. Manchmal decken sich die Elemente an ihren Rändern. Auch der Anteil, den die Grundsubstanz der Schale an deren Aufbau nimmt, kann sehr verschieden sein; in einigen Fällen berühren die Elemente einander nicht, sondern sind durch die Grundsubstanz getrennt.

Es kommt uns nicht unwahrscheinlich vor, dass der Aufbau der Schale nicht ausschliesslich vom Tiere bestimmt wird, doch dass auch das materialbeschaffende Medium in nicht geringem Maasse mitbestimmend wirkt. Die Elemente sind oft kaum noch als Idiosomen, d.h. vom Tiere selbst gebildet, anzusehen, wie das bei *Nebela* die Regel ist, doch mehr als nur geringfügig abgeänderte und etwas selektierte Bestandteile der Schalen anderer Rhizopoden oder nur als Quarzelemente der Umgebung.

3. Die Mundöffnung. Die Ausbildung des Mundrandes ist oft in weitgehender Übereinstimmung mit der Struktur des Schale. Wenn der Rand umsäumt ist von einer Reihe eckiger Elemente, treten die Formen auf, welche mit den Typus *N. vitraea* übereinstimmen. Bei den als *N. crenulata* zusammengefassten Formen ist die Mundspalte umrandet von einem welligen oder gezahnten Bande — „bourrelet ondulé" von PENARD —, aus einer stark lichtbrechenden Substanz gebildet; darin können einige Plättchen, wie sie auch die eigentliche Schale bilden, aufgenommen sein.

In vielen Punkten hat das indische Material unsere schon früher an diesem Formenkreis gewonnenen Ansichten bestätigt und verstärkt; daneben hatte es doch auch eigene Züge. Die indischen Populationen ergaben alle mehr oder weniger den *crenulata*-Typus; ausgesprochene *vitraea*-Formen haben wir darin nicht beobachtet. Meistens war die Struktur der Schale sehr regelmässig. Einige Schalen waren ganz aufgebaut aus fast runden Plättchen, sodass eine Struktur zustande kam, welche stark an die von *N. americana* oder *galeata* erinnerte. Dergleichen regelmässigen Strukturen hatten wir in europäischem Material niemals beobachtet. Mitunter glaubten wir feststellen zu können, dass die Bauelemente teilweise den Schalen von *Trinema* spec. entstammten, welche Art zahlreich in derselben Probe auftrat. Die *Nebela*-Schalen enthielten die gleichen zweierlei Elemente, grosse und kleine, nahezu kreisrunde Plättchen, wie *Trinema*, zu derselben Mosaik zusammengefügt, wie sie fur diese Art kennzeichnend ist.

Im allgemeinen stimmt die Grösse der Schale mit der früher von uns und Anderen gemessenen überein. Nur war das regelmässige Auftreten einiger sehr

breiten, fast kreisrunden Exemplare auffallend. Derartige breite Formen hatten wir noch nirgends angetroffen.

Grösse: lang 80 - 113, breit 65 - 92 μ; europäisches Material lang 80 - 127, breit 54 - 90 μ.

6. **Nebela galeata** f. **minor** (= *N. gracilis* PENARD?) (Fig. 15).

Diese *Nebela*-Form war in der Probe sehr zahlreich vertreten. Die Schale bestand aus nahezu kreisrunden oder breit-elliptischen Plättchen; immer waren sehr deutliche Lateralporen anwesend. Gewöhnlich war die Schale stark komprimiert und — in seitlicher Ansicht — am Fundus leicht zugespitzt. Ein „Kamm", entstanden durch stärkere Zusammendrückung der marginalen Schalenpartie, war entweder gar nicht oder nur sehr schwach entwickelt. Derartige kammlose Formen hatten wir auch in einer niederländischen Population (vom Zijpenberg, Rheden; s. unsere Publikation 1927) kennen gelernt; hier war sie in der Minderheit, während sie im indischen Material die Mehrzahl bildete. Im ganzen zeigten die indischen Individuen eine starke Konvergenz zu breiten Exemplaren von *N. americana;* nur ist die Grösse viel geringer als bei der letztgenannten Art und genau dieselbe wie bei den uns schon bekannten Populationen von *N. galeata* f. *minor*. Unserer Meinung nach gehört diese Population zu einem komplexen Formenkreis, als dessen extreme Typen wir ansehen möchten: 1. die Population von Telaga Saät (s.S. 229); 2. die typische *Nebela gracilis* von PENARD (1910); 3. *N. galeata* f. *minor* von Rheden. Dieser Komplex ist vielleicht von der *N. americana*-Gruppe äusserst schwierig oder gar nicht zu scheiden, besonders weil bei der letztgenannten Gruppe hin und wieder ebenfalls eine leichte Kammbildung auftritt. Es ist möglich, dass eine vergleichend-statistische Untersuchung dieser zwei Gruppen durchgreifende Unterschiede ans Licht bringen würde.

Grösse: lang 97 - 108, breit 51 - 54 μ.

7. **Nebela griseola** (Fig. 50 - 52).

Zum ersten Male wurde diese Art von einem der Stationen (Katoomba, Australien) der British Antarctic Expedition von PENARD (1911) beschrieben und zwar aus *Sphagnum,* im selben Jahre von ihm und WAILES aus Irland (Clare Island), wo sie aber schon 1909 beobachtet war und im folgenden Jahre von WAILES aus Nordamerika (Lakehurst). DEFLANDRE erwähnt sie ausserdem aus Frankreich und Deutschland, während wir sie in Material von zwei Stellen fanden (Poentjak-Pass, Java; Pik von Kerintji, Sumatra), an der ersten selten, an der zweiten allgemein. Weil es aber eine kleine und unscheinbare Art ist, besteht die Möglichkeit, dass sie hier oder da übersehen wurde.

Sie gleicht in allgemeinem Habitus der uns schon von früher bekannten *N. tenella,* unterscheidet sich davon aber in erster Linie durch den Bau des Mundrandes. Während dieser bei *tenella* nur mehr oder weniger verdickt oder angeschwollen ist, zeigt er bei *griseola* eine sehr ausgesprochene Umkrempelung, indem er deutlich nach aussen umgebogen und sein Saum nach oben gerichtet ist. Die graufarbene Schale ist nahezu birnförmig, nach dem Munde hin all-

mählich verschmälert, nicht oder nur sehr wenig seitlich zusammengedrückt, die Mundöffnung kreisförmig oder etwas elliptisch. Die Struktur ist sehr eigentümlich und fast identisch mit derjenigen von *N. tenella.* Der typisch nebeloide Habitus scheint nur ausnahmsweise entwickelt zu sein; gewöhnlich ist die chitinoide Grundsubstanz impregniert mit xenosomatischen Elementen allerlei Art, hauptsächlich Quarzkörnern verschiedener Form und Grösse und Diatomeenschalen, zwischen welchen nur selten elliptische oder runde Plättchen beobachtet werden, welche man für *Nebela*-Idiosomen halten könnte. PENARD sagt in seiner Diagnose, dass die Struktur sowohl derjenigen der Gattung *Nebela* als der Gattung *Lesquereusia* gleicht und die Schale in Struktur und Form gewissen Varietäten von *Difflugia pyriformis* ähnelt. Es ist dies auch unsere Erfahrung; nur fragt man sich ab, mit welchem Recht denn diese Form in die Gattung *Nebela* eingeteilt wird. PENARD antwortet hierauf: „grace à la nature particulière de son enveloppe", aber in seiner Diagnose findet man nichts davon.

Grösse:	lang	breit (in μ)
PENARD	70 - 75	———
WAILES und PENARD	80 - 85	———
WAILES	80 - 85	53 - 60
DEFLANDRE	70 - 85	50 - 58
Wir (Kerintji)	63 - 70	47 - 57
„ (Gedeh)	70 - 73	49 - 54

Wie man sieht, gehörten unsere Exemplare einer kleineren Grössenklasse zu als die bisher beobachteten.

8. **Nebela lageniformis** (Fig. 29 - 32).

Niederländische und ausserniederländische Materialproben (meist *Sphagnum*) hatten uns stets ein ziemlich einförmiges Bild dieser Art gegeben, sodass wir früher (1937) meinten feststellen zu können, dass dieselbe der Form und Grösse nach nur wenig variierte (Länge 110 - 125 μ). Spätere Beobachtungen an europäisches Material hatten im grossen ganzen diese Auffassung bestätigt; nur die ziemlich engen Grenzen der Schalenlänge wurden, wie zu erwarten, hier und da durchbrochen. Die meisten Populationen zeigten eine Schalenlänge von 100 - 125 μ; nur in einigen Fällen wurden Schalen mit einer Länge bis zu 145 μ gefunden.

Ein einziger Fundort (Finse, Norwegen) lieferte eine Population, welche eine grosse Verschiedenheit auch in der Form der Schale zeigte, insbesondere in der Ausbildung des Halses. Auch war hier die Abplattung der Schale nicht immer so stark wie gewöhnlich.

Viel deutlicher trat nun die Variabilität dieser Art in dem indischen Material auf; nur die Grösse war übereinstimmend: 97 - 143 μ.

Manchmal gab es stark vom Typus abweichende Formen, oder traten einige, jedes für sich nur geringfügige, Merkmale in konstanten Kombinationen auf, sodass es sich um mehr oder weniger wohl zu unterscheidenden Abarten handelte. Eine Probe lieferte zwei solche Formen nebeneinander, genügend scharf von einander abgegrenzt.

Die Variabilität der Schalenform betrifft hauptsächlich die folgenden Merkmale:

1. Fundusteil, der breit-elliptisch oder birnförmig sein kann.
2. Abplattung. Meistens ist die Schale sehr stark zusammengedrückt und haben Hals und Fundus nahezu die gleiche Dicke. In einigen Fällen war aber der Fundusteil stärker gewölbt und in der Seitenansicht des Halses deutlicher vom Fundus abgesetzt als gewöhnlich; diese Form meinen wir mit der var. *cordiformis* von Heinis (1914) identifizieren zu können.
3. Hals. Ist scharf abgesetzt oder geht allmählich in den Fundus über.
4. Mundrand. Dieser bildet zuweilen eine ausgesprochen gebogene Lippe; in anderen Fällen ist dagegen eine Lippe nicht nachzuweisen.
5. Struktur. Ist meistens die für die Nebeliden eigentümliche. Bisweilen waren die die Schale aufbauenden Plättchen nicht sehr scharf zu beobachten und war der Anteil der chitinösen Grundsubstanz überwiegend, wie das auch bei *N. tincta* wohl der Fall ist. Zwischen die typischen Bauelemente sind oft solche fremden Ursprungs eingestreut, gewöhnlich Idiosomen der Schalen anderer Rhizopoden.

9. **Nebela martiali** (Fig. 37 - 41).

Das auffallendste Merkmal, welche diese Art sofort von fast allen anderen dieser Gattung unterscheidet, ist der Besitz von zwei Poren auf der Frontalseite der Schale; nur *N. certesi* und *bigibbosa* haben dieses Merkmal mit ihr gemein, sind aber durch einige andere Details ziemlich sicher von ihr zu trennen.

Nebela martiali hat eine stark abgeplattete, in Umriss birnförmige Schale mit einem breit-elliptischen Fundusteil, der allmählich in einen kurzen Hals übergeht; nur in wenigen Fällen ist der Hals etwas schärfer abgesetzt.

Am Übergang des Fundus zum Hals befindet sich meistens jederseits eine gut wahrnehmbare Lateralpore, durch eine seitliche Ausbiegung der Konturlinie markiert. Nebenan liegen auf der Breitseite die meist braun umrandeten Frontalporen, ebenfalls eine auf jeder Seite. In dieser Höhe nimmt eine mehr oder weniger ausgesprochene Wulstbildung am Rande der Schale ihren Ursprung. Dadurch und durch ihre allgemeine Form gleicht die Schale sehr derjenigen von *N. galeata* und auch denjenigen Individuen von *N. tubulosa,* welche eine solche Wulstbildung besitzen. Die Übereinstimmung mit diesen Formen von *N. tubulosa* trifft noch mehr, wenn man auch die Schalenstruktur mit in Betracht zieht. Auch hier eine gelblich braune, chitinöse, biegsame Grundsubstanz, in welcher oft wenig deutlich wahrnehmbare Quarzplättchen eingebettet liegen. Am Fundus ist diese Struktur noch am besten zu beobachten. Meistens besteht hier die Schale aus zahlreichen kleinen, runden oder quadratischen (in letzterem Falle wohl *Quadrula*) Plättchen, wozwischen feinkörniges Material eingefügt ist, das Ganze erinnernd an die typische Struktur der Schale von *N. tubulosa.* In wenigen Fällen ist die Schale aufgebaut aus kleinen gut aneinander schliessenden Plättchen.

Die Frontalseiten des Halses sind immer mit einer Anzahl runder, stark lichtbrechender, perlähnlicher Körner besetzt. Meistens ist aber eine Zone längs der Mittellinie ohne diese Perlen. Den Besitz dieser Bildungen hat *N. martiali* gemein mit *N. certesi* und unterscheidet diese beiden Arten von *N. bigibbosa*. Bei *N. certesi* ist aber immer zwischen den beiden Perlenreihen eine scharf markierte Längsfurche zu bemerken; auch besteht zwischen beiden Formen ein deutlicher Grössenunterschied.

An auf ihre Kante gelegten Schalen ist festzustellen, dass die Frontalporen der Vorder- und Hinterseite beiderseits durch eine, die Schale durchbohrende Röhre verbunden sind. In vielen Fällen war die Öffnung an der einen Seite trichterförmig in die Schalenfläche eingesenkt, während diejenige der anderen Seite auf einer leichten Erhebung lag. Manchmal war auch die eingesenkte Pore auffallend durch eine braune Umrandung, während die Öffnung der anderen Seite unansehnlich und ohne jede spezielle Begrenzung war. Ob der Tubus zwischen den Öffnungen auch noch mit dem Innenraum der Schale kommuniziert, war nicht festzustellen, wie überhaupt die Bedeutung dieser Bildung noch ganz rätselhaft ist, angenommen dass sie eine Bedeutung hat.

Die Dimensionen der Schalen der verschiedenen Fundorten waren unter einander sehr übereinstimmend und auch nahezu gleich den Angaben anderer Autoren; dies deutet auf eine ziemlich einheitliche Form.

Grösse: lang 153 - 180, breit 95 - 130 μ. PENARD gibt als Länge 165 - 180 μ; DEFLANDRE als Länge 155 - 170, als Breite 85 - 91 μ an.

10. **Nebela militaris** und **tubulata** (Fig. 21 - 28).

Nebela militaris hat sich nach unseren bisherigen Beobachtungen als sehr einförmig und auch der Grösse nach als wenig variabel ergeben.

In verschiedenen Proben des indischen Materiales haben wir diese Art gefunden und war ihre Grösse übereinstimmend mit früheren Befunden (s. aber S. 235). Die Form der Schale ergab sich aber als etwas weniger konstant; besonders war oft eine schärfere Scheidung von Fundus und Hals ausgebildet. Der Struktur der Schale und der Lippenbildung nach waren aber diese Individuen dem Typus völlig gleich und neben ihnen traten auch immer zahlreiche typische Individuen auf.

In einigen Proben kam neben der typischen *N. militaris* eine *Nebela*-Form vor, welche in Struktur und Lippenbildung der *militaris* ganz gleich war, aber eine so ausgesprochene Trennung von Fundus und Hals zeigte, dass die Form der Schale sehr derjenigen von *N. lageniformis* ähnelte. Typus und Nebenform waren, wenn in derselben Probe anwesend, immer fast ohne Übergänge. Die Länge der beiden Formen war die gleiche, die Breite der Nebenform übertraf aber die des Typus. Wir glauben hier der von BROWN (1911) als *N. tubulata* beschriebenen Form begegnet zu sein, welche uns bisher nur aus der Literatur bekannt war.

Die von BROWN seinen Mitteilungen beigegebenen Zeichnungen führten uns zuerst zu der Annahme, dass es sich hier handelte um eine kleine Nebenform

von *N. lageniformis*. Jezt aber, wo wir das Objekt beobachten konnten, meinen wir eher dass diese Art neben *N. militaris* zu stellen sei, mit der sie in Grösse und Struktur der Schale und in der Ausbildung des Mundes tatsächlich mehr Übereinstimmung zeigt. Auch WAILES und PENARD (1911) sind dieser Meinung, während WAILES in CASH, HOPKINSON and WAILES (1919) mehr auf eine Verwandtschaft mit *N. lageniformis* hindeutet.

Es wäre also noch zu prüfen, ob auch in anderen Fällen die Trennung der *N. tubulata* von *N. militaris* und *lageniformis* immer durchzufüren sei. In unserem Material war *tubulata* im allgemeinen durch ihre Grösse von *lageniformis*, durch ihre Form von *militaris* zu scheiden, aber eine Probe ergab, wie schon erwähnt, eine Population von *militaris*, welche mehrere Individuen enthielt, welche einigermaassen zu *tubulata* konvergierten.

An einigen Individuen konnten wir das Vorkommen eines Lateralporenpaares feststellen.

Grösse: *militaris* lang 60 - 77, breit 30 - 43 μ.; einige ostindischen Individuen lang 84, breit 51 μ.; *tubulata* lang 60 - 67, breit 30 - 33 μ.

11. **Nebela tincta** (Fig. 11 - 14).

Diese Art war in dem ostindischen Material eine regelmässige Erscheinung. Die Beobachtungen stimmten der Hauptsache nach mit unseren früheren an europäischem Material überein.

Immer zeigte die Schale die für diese Art kennzeichnende laterale Poren, wenn auch nicht immer gleich gut wahrnehmbar. Die Struktur der Schale gab wieder eine grosse Mannigfaltigkeit zu sehen: deutliche *Nebela*-Struktur mit gut aneinander schliessenden Quarzplättchen, oder unscharfe, nicht zusammenschliessende, zerstreute Plättchen, oder nahezu strukturlose, ganz aus der chitinösen Grundsubstanz aufgebaute Schalen. Nur die Grössenverhältnisse ergaben hier und da überraschende Abweichungen, welche wertvolle Ergänzungen unserer früherer Befunde bedeuteten.

Für den Typus hatten wir damals feststellen können: Länge 78 - 97, Breite 62 - 82 μ. Daneben waren eine grosse und eine kleine Abart vorhanden, die erste lang bis 122 und breit bis 103 μ, die zweite lang bis 71 und breit bis 52 μ. Hier und da wurden einige Individuen beobachtet, deren Länge und Breite einander fast gleich kamen.

Die Populationen des ostindischen Materiales wiesen meistens keine grosse Abweichungen von diesem Typus auf; nur lag der Mittelwert etwas höher: lang 80 - 116, breit 57 - 108 μ. Einige Proben ergaben aber abweichende und auffallende Resultate.

Erstens wurden in einem Fall die obengenannten Maasse bedeutend überschritten und gab es Individuen von einer Länge bis 165 und einer Breite bis 159 μ.

Zweitens trat manchmal in ziemlich grosser Individuenzahl eine Nebenform auf, deren Länge von der Breite übertroffen wurde und welche also die Gestalt der *Nebela flabellulum* vortäuschte. Immer zeigten diese Individuen aber die

typischen Merkmale der *N. tincta:* den Besitz eines Paares Lateralporen und die eigentümliche Struktur der Schale. Diese Nebenform ist also bestimmt nicht der *N. flabellulum* gleichzusetzen, die wir in einer früheren Arbeit (1937) erwähnten und neben die *N. collaris* zu stellen war.

Vorläufige Messungen und Zählungen machen wahrscheinlich, dass hier wie bei *N. collaris* neben dem Typus eine statistisch selbständige Form auftritt, welche durch ihre Breitschaligkeit der *N. flabellulum* gleicht, wie das auch schon von anderen Autoren behauptet worden ist.

Grösse der flabelluloiden *tincta*-Form: lang 97 - 118, breit 105 - 117 μ; ein Individuum lang 101, breit 140 μ.

12. **Nebela vas** (Fig. 46 - 49).

Diese Art war uns bisher aus eigener Anschauung nur durch ein Dauerpräparat PENARDS bekannt, aus Material auf Neuseeland gesammelt von der British Antarctic Expedition. Sie wurde von CERTES (1889) in Weihern bei Kap Horn entdeckt, wo sie sehr allgemein war. Die Schale gleicht einigermaassen derjenigen von kurzen, gedrungenen Individuen von *Nebela lageniformis,* hat aber meistens eine sehr stark ausgesprochene Einschnürung am Übergang vom Fundus in den Hals, welche oft den Charakter einer Ringfurche annimmt, und eine mehr oder weniger deutliche Anschwellung der Halsbasis oberhalb dieser Furche. Die Schalenstruktur ist typisch nebeloid; CERTES erwähnt Individuen, deren Plättchen eine ausserordentliche Grösse und Regelmässigkeit besassen; solche haben wir nicht beobachtet.

Darauf wird diese *Nebela*-Art erwähnt von PENARD (1911) in den Resultaten der British Antarctic Expedition und zwar aus der Antarktis, dem südlichen und zentralen Pazifik, Neuseeland, Australien und Canada. Letztere auch bei WAILES (1913) vorkommende Angabe beruht, wie auch DEFLANDRE (1936) für wahrscheinlich hält, auf einer Verwechslung von British Columbien mit dem gleichnamigen südamerikanischen Lande; wo aber PENARD (l.c. p. 248) ausdrücklich über Schalen aus Vancouver (d.h. Canada) Bemerkungen macht, ist es fast unmöglich, an eine solche Verwechslung zu glauben. Ist diese Angabe tatsächlich richtig, so würde das der einzige Fund dieser Art auf der nördlichen Halbkugel sein. Weiter wird sie (1914) von HEINIS angegeben für vier Fundstellen in Columbien (Südamerika) und für Peru, während DEFLANDRE ausserdem noch Chili und Brasilien nennt.

Unsere Fundstellen dieser Art waren: 2 am Pik von Kerintji, 1 bei Tjibodas, 4 am Gedeh, meistens in vielen Exemplaren.

PENARD und HEINIS haben Individuen beobachtet, welche unter normalen Schalenplättchen fremde, xenosomatische Elemente besassen, die unzweideutig als *Euglypha*-Idiosomen erkannt werden konnten; wir haben solche nicht gesehen, vielmehr eine grosse Einförmigkeit in der Schalenstruktur bemerkt. Wenn die von HEINIS geäusserte Vermutung, dass diese Plättchen von erbeuteten und aufgefressenen *Euglypha*-Individuen herkömlich sein würden, richtig ist, so würde diese, auch bei anderen *Nebelae* beobachtete Erscheinung ein proto-

zoologisches Analogon darstellen zu dem bekannten Fall der Nacktschnecken aus der Gruppe der Aeolidier, welche sich mit Polypen ernähren und deren Nesselzellen in bestimmten Teilen ihres Körpers aufbewahren.

Grösse	lang	breit (in μ)
Certes	150 - 170	———
Heinis	120, 210	———
Penard	95, 160 - 165	———
Wailes	130 - 155	85 - 103
Wir (Kerintji)	130 - 143	80 - 87
„ (Tjibodas)	130 - 153	90 - 110
„ (Gedeh)	113 - 150	73 - 100

Deflandre bemerkt zu den ziemlich weit auseinandergehenden Maassen der älteren Autoren, dass sich später bei dieser Art vielleicht verschiedene Grössenklassen („variétés") unterscheiden lassen; Penard teilt mit, dass an verschiedenen Orten neben einer Form der normalen Grösse eine andere „plus claire, plus délicate, et beaucoup plus petite" auftrat, welche nur 95 μ maass und nicht durch Zwischengrössen mit dem Typus verbunden war; an einem der Fundorte war nur diese kleine Form anwesend.

IV. DIE *QUADRULA*-ARTEN DES MATERIALES.

Merkwürdigerweise war die typische, in Europa allgemeine *Quadrula symmetrica* niemals in unseren ostindischen Proben zu bemerken (s. aber S. 224). Statt dieser Art konnten wir aber einige andere beobachten, welche wir bisher noch nicht angetroffen hatten.

1. **Quadrula scutellata** (Wailes) (Fig. 64 - 66).

Wie bei *Q. symmetrica* ist die Schale aufgebaut aus quadratischen Plättchen von ziemlich gleichmässiger Grösse, welche aber an den Ecken von kleineren überdeckt sind. Meistens ist bei jedem Zusammenstoss von einigen der grossen Quadrate ein solches Nebenplättchen zu finden; doch können sie auch stellenweise vermisst werden.

In der Regel ist die Schale birnförmig ohne ausgesprochene Ausbildung eines Halses; doch war sie in wenigen Fällen zur Mundöffnung hin etwas röhrenförmig ausgezogen.

Eine Probe gab eine Population dieser Art, welche vom Typus abwich durch eine auffallende Halsbildung, wodurch die Schale die Flaschenform bekam. Oft war eine leichte Einschnürung beim Ansatz des Halses an dem Fundus zu beobachten; dadurch bekam diese Form eine gewisse Ähnlichkeit mit der von *N. vas,* sodass wir diese Form unterscheiden möchten als *Q. scutellata* var. *vas* (s. auch S. 214).

Grösse: lang 123 - 160, breit 53 - 93 μ.

2. **Quadrula tropica** (Fig. 60 - 62).

Die Schale ist aus vielen kleinen Plättchen aufgebaut, welche eng aneinander schliessen ohne sich zu überdecken. Zwischen diese quadratische Plättchen liegen manchmal einige runde eingestreut. Es handelt sich vielleicht um eine variable Art; schon die beiden Stationen, welche sie lieferen, führten eine Population von etwas verschiedenem Habitus. Gewöhnlich ist die Schale birn- oder kolbenförmig. Viele Exemplare hatten eine Schalenform, welche der der *N. militaris* stark ähnelte. Dazu konnte an einigen Individuen die Anwesenheit von lateralen Poren konstatiert werden. Diese Tatsache ist darum bemerkenswert, da auch andere Autoren angeben, dass diese Art die Neigung besitzt Formen auszubilden, die in die Richtung von *N. militaris* gehen. So sagt DEFLANDRE: „cette petite espèce a tendence, d'après Wailes, à présenter une forme générale voisine de celle de la *N. militaris*".

Inwieweit diese Übereinstimmungen Grund geben zur Zusammenschmelzung der Gattungen *Quadrula* und *Nebela,* wie das von DEFLANDRE vorgeschlagen wird, wollen wir dahingestellt sein lassen.

Grösse: lang 70 - 95, breit 38 - 53 μ.

3. **Quadrula plicata** nov. spec. (Fig. 58, 59).

In Probe Nr. X (von Kerintji) wurde in ziemlich grosser Zahl eine *Quadrula*-Form aufgefunden, die mit keiner anderen aus der Literatur identifiziert werden konnte. In der Struktur der Schale stimmte sie am meisten mit *Q. quadrigera* und *Q. tropica* überein, der Grösse nach am meisten mit *Q. quadrigera.*

Die Schale war, wie bei den beiden genannten Arten, aufgebaut aus kleinen quadratischen Plättchen, wozwischen oft einige unregelmässig vieleckige oder runde aufgemerkt werden konnten.

Das auffallendste Merkmal bildet aber die von den übrigen *Quadrula*-Arten abweichende Schalenform. Die Schale ist im allgemeinen schlank birnförmig. Auf einem Drittel der Schalenlänge, am Übergang vom Halse zum Fundus, befindet sich beiderseits eine Anschwellung auf der Schalenoberfläche, welche die Stelle einer Lateralpore markiert. An dieser Stelle nimmt eine wulstförmige Umrandung des Fundus ihren Ursprung, eine Bildung, welche eine gewisse Ähnlichkeit mit der „galea" bei *N. galeata* hat. Dadurch bekommt die Schalenoberfläche ein mehr oder weniger gefaltetes Aussehen, worauf sich der Artname *„plicata"* bezieht. Auf der Schmalseite der abgeplatteten Schale zeigt der Wulst sich als eine Zuspitzung des Fundusbodens.

Die die Schale aufbauenden Plättchen reichen nicht bis zum Mundrand; dieser ist wie bei *Q. tropica* von einem schmalen chitinösen Saum umgrenzt.

Quadrula plicata wurde zusammen mit *Q. tropica* angetroffen. Mit dieser Art war sie aber nicht durch Übergänge der Schalenform verbunden und auch der Grösse nach bildeten die beiden Arten gut von einander abgegrenzte Populationen.

Grösse: lang 111 - 135, breit 49 - 62 μ.

4. **Quadrula ?symmetrica** (Fig. 63), s.S. 224.

V. ZUSAMMENFASSUNG. SCHLUSSBEMERKUNGEN.

Moosbewohnende Rhizopoden aus den Tropen und der südlichen Hemisphäre sind zwar bisher wiederholt Gegenstand mehr oder weniger ausführlicher Darstellungen gewesen, aus Niederländisch Ostindien dagegen mit nur wenigen Ausnahmen noch nicht untersucht worden. Bei der bekannten Annahme der im allgemeinen kosmopolitischen Verbreitung der Süsswasser-Rhizopoden hat eine solche Untersuchung von zoogeographischem Standpunkt aus nur eine sehr bedingte Bedeutung; weil aber nicht wenige Arten noch sehr unvollständig bekannt sind und ausserdem einige von ihnen auf der südlichen Hemisphäre beschränkt zu sein scheinen, sind faunistische Beobachtungen über diese Gruppe an Material von neuen Fundstellen doch nicht ohne ein gewisses Interesse.

Richters (1907) macht einige Angaben über Moosrhizopoden aus Sumatra, Banka und Java. An bzw. 3, 13 und 3 Fundstellen dieser Inseln wurden Moosproben gesammelt, welche insgesamt 15 Rhizopodenarten lieferten, über 10 Gattungen folgendermaassen verteilt: *Amoeba* 1, *Difflugia* 3, *Trigonopyxis* 1, *Euglypha* 2, *Assulina* 1, *Quadrula* 1, *Nebela* 4, *Arcella* 1, *Trinema* 1. Bemerkenswert dabei ist erstens das Fehlen von *Assulina muscorum,* während *A. seminulum* einige Male beobachtet wurde; zweitens — in Vergleich mit den Befunden von Harnisch (s.S. 253) — das Zurücktreten in Artenzahl der Gattung *Difflugia* gegenüber der Gattung *Nebela.* Von der letzteren wurden beobachtet: *collaris* an 6, *bursella* an 2, *caudata* und *vas* je an 1 Fundstelle, bzw. auf Banka — nur in einem Exemplar — und auf Java, in *Rhizogonium*-Rasen am Papandajan. Von *Trigonopyxis arcula* — angeführt als *Difflugia a.* — wurde von Banka eine neue Varietät *fabiformis* beschrieben, welche sich durch die länglich-elliptische Gestalt und die Form der Mundöffnung — ein gleichschenkliges statt eines gleichseitigen Dreiecks — vom Typus unterscheidet und auch auf Ascension vorkommen soll.

Die Liste von Van Oye (1922) nennt im ganzen 22 Arten von thekamoeben Rhizopoden von Java, auf 9 Gattungen also verteilt: *Arcella* 1 (mit 2 Varietäten), *Difflugia* 12, *Lesquereusia* 1, *Heleopera* 1, *Nebela* 2, *Hyalosphenia* 1, *Gromia* 1, *Euglypha* 2, *Amphitrema* 1. Hier fällt wie bei Harnisch das ungünstige Verhältnis der Anzahl *Nebela*-Arten den *Difflugia*-Arten gegenüber besonders auf: 2, d.h. 9% gegen 12 d.h. 59%. Es ist dies wohl die Folge davon, dass das Material hauptsächlich in offenen Wasseransammlungen (Weiher, Teiche und Seen) gesammelt wurde; nur bei *Euglypha brachiata* wird angegeben: „parmi la mousse". Die beobachteten *Nebela*-Arten sind *collaris* und *vitraea,* jede von nur einer Fundstelle; die Arten der südlichen Hemisphäre fehlen alle.

Ausführlicher und wichtiger ist die Arbeit von Harnisch (1932) über die Rhizopoden der Deutschen Limnologischen Sunda-Expedition. Einige der nach unserer Ansicht wichtigsten Punkte dieser Arbeit seien hier kurz wiedergegeben.

Harnisch untersuchte im ganzen über 200 in Formol konservierte rhizopodenhaltige Proben aus Java, Sumatra und Bali, welche den nachfolgenden

Biotop-Arten entstammten: 1. Quellen; 2. Bach und Fluss; 3. Wasserfälle und Feuchtwände; 4. heisse Quellen; 5. Teich und Sawah; 6. Seen; 7. durch *Sphagnum* beeinflusste Gewässer. Bei jeder der im ganzen 67 beobachteten Arten werden angegeben: die Gesamtzahl der Individuen, die Gesamtzahl der Fundstellen, die Biotop-Art, die Insel von Herkunft und bei den meisten auch die pH-Grenzwerte, bei denen sie angetroffen wurden.

Die 67 Arten verteilten sich folgenderweise über 20 Gattungen:

Difflugia 20, *Centropyxis* 4, *Pontigulasia* 1, *Lesquereusia* 2, *Hyalosphenia* 1, *Nebela* 6 (+ 1 zweifelhafte), *Quadrula* 1, *Heleopera* 2, *Arcella* 4, *Pyxidicula* 1, *Phryganella* 2, *Cryptodifflugia* 2, *Platoum* (??) 1, *Pseudodifflugia* 4, *Cyphoderia* 1 (+ 1 zweifelhafte), *Euglypha* 8, *Assulina* 1, *Sphenoderia* 1, *Trinema* 3, *Corythion* 2. HARNISCH schliesst die Artenliste mit der folgenden Bemerkung: „Die vorstehende Liste könnte im allgemeinen auch eine Liste über eine Rhizopodenaufsammlung in gemässigten Breiten sein. Besondere Formen können, wie es ja auch bei dem Kosmopolitismus der Protozoen zu erwarten ist, nicht namhaft gemacht werden. Höchstens könnten einige Vertreter der Gattung *Nebela* Besonderheiten bieten, doch kann bei dem mir zur Verfügung stehenden verhältnismässig geringen, konservierten Material darauf kein Wert gelegt werden. Beachtenswerter ist vielleicht das Fehlen mancher (besonders sphagnophiler) Formen in dem Material."

Darauf folgt ein Abschnitt mit der Überschrift: „Biozönotische Betrachtungen", in welchem nach einander besprochen werden: 1. die Litoralregion der Seen; 2. die tieferen Regionen derselben; 3. Quellgebiete; 4. heisse Quellen; 5. Solfataren; 6. fliessende Gewässer; 7. durch Sphagnen veränderte moorige Gebiete, von denen besonders die letztere eine eingehende Darstellung erfahren und in den folgenden Worten zusammengefasst werden: „Es ist nach diesen Daten wohl keine Frage, dass die Rhizopodenfauna der von der Expedition untersuchten, sehr jungen Moorgebiete mit der unserer Moorgebiete nicht verglichen werden kann. Leider kennen wir die wesentlichen Bedingungen, die in unseren Breiten manche Arten (z.B. *Nebela militaris, N. galeata* und *marginata*) an Sphagnen und manche Arten (wie *Hyalosphenia papilio* und *elegans, Amphitrema flavum* und *wrightianum*) an Moore, insbesondere Hochmoore binden, noch nicht genügend, um mit Sicherheit sagen zu können, dass die fraglichen Bedingungen in den Tropen nicht verwirklicht sind. Es besteht aber sicher auch die Möglichkeit, dass diese Formen aus geographischen, historischen Gründen fehlen, dass sie die fraglichen Gebiete nicht oder noch nicht haben erreichen können. Ganz abgesehen davon, dass sie vielleicht an sich verhältnismässig schwer ausbreitbar sind, ist die Aussicht auf eine erfolgreiche Verschleppung bei der ausserordentlichen Seltenheit geeigneter Lebensgebiete in den Zwischengebieten zwischen den Mooren und besonders Hochmooren gemässigter Breiten und diesen tropischen Gegenden ausserordentlich gering. Jedenfalls widersprechen die Befunde an der Rhizopodenfauna der Moorgebiete der Sunda-Inseln in keiner Weise der Auffassung der Rhizopodenfauna der Moore gemässigter Breiten, die ich verschiedentlich vertreten habe".

In einem Zusatz giebt A. THIENEMANN eine tabellarische Übersicht der Zahl der Fundstellen und beobachteten Individuen für jede Art, ebenso der einzelnen Fundstellen und Rhizopodenformen nach den Biotop-Arten geordnet.

Wir möchten dazu folgendes bemerken. Es fehlen bei der HARNISCH'schen Arbeit erstens alle Literaturhinweise und zweitens ein gerade bei dieser Gruppe so sehr gewünschtes umfangreiches Abbildungsmaterial; die 6 beigegebenen Abbildungen sind nur so schematisch gehaltene Schalenumrisse, dass daraus nicht viel zu machen ist. Dabei müssen wir auf einen typischen Fall zweifellos unrichtiger Bestimmung hinweisen. In Abb. 1 wird nämlich eine „*Difflugia elegans*" dargestellt, von welcher Art insgesamt 47 Individuen beobachtet wurden und zwar eine abweichende Form mit mehrdorniger Schale. Nun ist diese wenigsagende Abbildung nach unserer Meinung doch eben zureichend um zu zeigen, dass die abgebildete Form gar keine *Difflugia,* sondern eine *Nebela* ist und zwar sicher *Nebela caudata,* eine Art, welche HARNISCH gar nicht nennt. Ausserdem werden die Schlussfolgerungen biozönotischer Art oft an die Beobachtung und Bestimmung sehr weniger Individuen geknüpft, bisweilen selbst von einem einzelnen. So wurden z.B. beobachtet von *Difflugia pyriformis* var. *lacustris* 2, *D. manicata* 1, *D. pulex* 1, *D. acuminata* 2, *D. lanceolata* 1, *D. viscidula* 1, *D. avellana* 1, *Hyalosphenia elegans* 1, *Heleopera picta* 1, *Pseudodifflugia fascicularis* 1, *Trinema complanatum* 1, *Corythion dubium* 2 Individuen. Bedenkt man dabei, dass es sich hier vielfach um „Arten" handelt, deren unterscheidende Merkmale noch keineswegs so scharf umschrieben sind, dass eine einwandfreie Bestimmung leicht oder eben möglich wäre, besonders nicht, wenn man nicht über eine individuenreiche Population verfügt, so scheint es geboten, der Artenliste von HARNISCH und noch mehr den daraus gezogenen Schlüssen mit der nötigen Vorsicht entgegen zu treten.

Auch in Hinsicht auf die biozönotischen Schlussfolgerungen an sich gibt die HARNISCH'sche Arbeit einer gewissen Skepsis Raum. Von den Faktoren des besiedelten Milieus wird namentlich der pH-Wert hervorgehoben; dieser ist aber bei der grossen Mehrheit der Arten so ausserordentlich variabel, dass Schlüsse von einiger Bedeutung daraus nicht zu ziehen sind. So lehrt uns die erste Tabelle von THIENEMANN nicht nur, dass für die 23 häufigsten Arten des Materials der pH-Wert schwankt zwischen 3.08 und 9.2, sondern auch, dass bei jeder dieser Arten für sich Differenzen dieses Wertes auftreten, welche mehrere Einheiten, im Minimum 2.9, im Maximum 5.32, im Mittel $\pm$ 4 betragen; die stark ausgesprochene Euryionie dieser Arten geht daraus deutlich hervor. Ebenso ergibt sich aus der Tabelle, dass weithin die meisten dieser Arten entweder in allen 7 Biotop-Arten vorkommen oder doch wenigstens in der Mehrzahl davon; von einer engen Gebundenheit an ein bestimmtes, durch andere Merkmale als der pH-Wert gekennzeichnetes Milieu kann also ebensowenig die Rede sein.

Bei der Besprechung der Gattung *Nebela* macht HARNISCH die Bemerkung, dass das Studium der Formen dieser Gattung dadurch erschwert war, dass die in Moosen und Mooren unserer Breiten vorkommenden Formen, die ihn aus eigener Anschauung bekannt waren, fast ganz fehlten und Formen vorherrschten,

die ihm bislang noch gar nicht oder kaum zu Gesicht gekommen waren; zudem wurden einige dieser Formen stets nur in einzelnen Schalen gefunden. Es wäre — nach HARNISCH — durchaus möglich, dass hier z.T. (namentlich bei *N. lageniformis* und *americana*) doch von den bislang aus gemässigten Breiten beschriebenen Arten verschiedene Formen vorliegen. Bei dem verhältnismässig geringen Material konservierter Schalen, dass ihm zur Verfügung stand, musste versucht werden, diese mit bekannten Arten zu identifizieren.

Wenden wir uns nun zu unseren eigenen Beobachtungen, so müssen wir zuvor noch einmal daran erinnern, dass unser Material nur aus einer einzigen Biotop-Art stammte und zwar aus einer solchen, aus der HARNISCH keine Proben zur Verfügung standen, nämlich aus auf dem Boden oder an Bäumen wachsenden Moosen, unter denen die *Sphagnales* fehlten, weil es uns bisher nicht gelungen ist, solche in die Hände zu bekommen. So fehlen, wie schon in der Einleitung bemerkt wurde, direkte Vergleichungspunkte zwischen den HARNISCH'schen Resultaten und den unsrigen. Wir beschränken uns daher auf folgende Bemerkungen.

Der Umfang unseres Materiales war sehr viel geringer als derjenige von HARNISCH. Ihm standen über 200 Proben zu Gebote, wir untersuchten deren im ganzen nur 25, von denen 17 in dieser Arbeit beschrieben worden sind, weil die übrigen eine zu geringe Bedeutung hatten um berücksichtigt zu werden. Während HARNISCH, der von an Schalen reicherem Material 2 - 3 Deckglasproben, von dem ärmeren mehr, oft den ganzen Inhalt des Gläschens, untersuchte, im ganzen 3810 Individuen beobachtete, haben wir die gesamte Individuenzahl nicht bestimmt und können dieselbe nur schätzungsweise angeben; sie beläuft sich aber sicher auf mehrere Tausende. Oft wurden in einem einzigen Deckglaspräparat mehrere Hunderte von Individuen gezählt. Aus dieser Vergleichung ergibt sich die uns schon aus dem Studium europäischen Materials geläufige Tatsache, dass gerade Moose die an Rhizopoden reichsten Milieus darstellen. Im höchsten Grade ist dies bei den *Sphagnales* der Fall; wie THIENEMANN bemerkt, gehören denn auch in dem HARNISCH'schen Material die *Sphagnum*-Gewässer mit im Durchschnitt 62 Individuen pro Fundstelle zu den von den Rhizopoden am meisten bevorzugten Aufenthaltsorten, worin sie aber den Wasserfällen mit 76 Individuen pro Fundstelle noch etwas nachstehen.

Betrachten wir nun die Liste der von uns beobachteten Gattungen, so sehen wir, dass diese davon im Ganzen 17 enthält gegen 20 bei HARNISCH; scheiden wir aber von diesen 20 zunächst die zwei aus, welche HARNISCH selber anzweifelt (*Hyalosphenia, Platoum*) und von denen jede nur in einem einzigen Exemplar vorlag, dann reduziert sich diese Zahl nahezu auf die Höhe der unsrigen. Aber unter den dann noch restierenden 18 gibt es einige, welche sowohl der geringen Anzahl der beobachteten Individuen als der schwierigen Bestimmung wegen uns mehr oder weniger bedenklich vorkommen, so z.B. die Formen der Gattungen *Pontigulasia, Pyxidicula* und *Sphenoderia,* besonders weil die HARNISCH'schen Angaben weder durch sorgfältige Umschreibungen noch durch überzeugende Abbildungen gestützt sind.

Wir kommen nun zu den Arten, von denen Harnisch 67 anführt. Zählen wir zunächst in unserem Material die mehr oder weniger zweifelhaften und nicht genau zu bestimmenden mit, so bekommen wir folgende Zahlen: *Arcella* 3, *Centropyxis* 7, *Bullinula* 1, *Trigonopyxis* 1, *Difflugia* 4, *Heleopera* 5, *Hyalosphenia* 1, *Nebela* 17, *Quadrula* 3, *Phryganella* 3, *Cryptodifflugia* 1, *Euglypha* 7, *Assulina* 2, *Sphenoderia* 3, *Placocista* 2, *Corythion* 1, *Trinema* 3, im ganzen also 64 Arten, d.h. etwas weniger als die Zahl der Arten von Harnisch. Bei diesen Arten sind aber nicht weniger als 17 nach unserer Meinung zweifelhaft und also nur 43, deren Bestimmung wir als genügend fundiert ansehen möchten. Dieses relativ ungünstige Verhältnis der gut und unsicher bestimmten Arten wird z.T. zweifellos dadurch bedingt, dass wir auf Grund langjähriger Erfahrungen in dieser Gruppe in vielen Fällen bei der versuchten Identifizierung einer Form („Art") uns einen definitiven Schluss vorbehalten, wo Andere vielleicht gemeint hätten, eine sichere und unfehlbare Entscheidung treffen zu können. Wir haben bereits an anderer Stelle (1937) den Grund dieses Verfahrens ausführlicher erörtert. Besonders wenn kein sehr umfangreiches Material vorliegt, ist bei vielen Formen eine Zurechnung zu dieser oder jener „Art" gar nicht möglich.

Die genaue Betrachtung unserer Liste lehrt weiter, dass in Vergleich zu der Harnisch'schen Liste die Gattung *Difflugia* in Artenzahl stark zurücktritt. Gegen 21 Arten bei Harnisch von denen allerdings eine, *D. arcula*, abgezogen werden muss, weil wir dieselbe als *Trigonopyxis arcula* anführen, sind bei uns nur 3 *Difflugia*-Arten sicher und 1 zweifelhaft angegeben. Das ist aber ganz in Übereinstimmung mit unseren früheren Befunden an europäischem Material, aus denen hervorging, dass die Gattung *Difflugia* eben in Moosen, sowohl *Sphagnales* als anderen *Bryales*, immer nur sehr dürftig vertreten, dagegen ein normaler Bewohner vom Sapropelium und z.T. auch vom offenen Wasser ist. Auch aus den Resultaten der British Antarctic Expedition ergibt sich diese Tatsache sehr deutlich.

Gerade das Gegengesetzte gilt von der Gattung *Nebela*. In unserem Material war sie durch 17 Arten, d.h. fast 27% der gesamten Artenzahl vertreten; dagegen zählt die Harnisch'sche Liste im ganzen nur 5 sichere und 1 zweifelhafte Art dieser Gattung auf, d.h. ± 8% der gesamten Artenzahl; dabei wird die schon S. 250 zitierte Bemerkung gemacht. Die von Harnisch beobachteten *Nebela*-Arten sind:

1. *N. collaris;* nur 2 Funde in 3, bzw. 2 Schalen, beide etwas fraglich.
2. *N. tubulosa;* 41 Individuen in 6 Funden, ziemlich sicher identifizierbar.
3. *N. lageniformis;* ziemlich regelmässig, wenn auch meist in einzelnen Exemplaren.
4. *N. americana* (bei einigen Schalen Abgrenzung gegen *lageniformis* nicht leicht); 2 Funde.
5. *N. crenulata* (= *dentistoma*); 2 Funde, 31, bzw. 6 Exemplare.
6. *N. tenella* (?); 2 — etwas zweifelhafte — Funde, 2, bzw. 2 Exemplare.

Bei der Betrachtung dieser Liste fällt nun — ausser der Dürftigkeit des Materiales — besonders auf, dass es sich sämtlich um Arten handelt, welche

auch an europäischen und anderen Fundstellen am wenigsten selten, oft dagegen massenhaft vertreten sind. Etwas wunderlich mutet denn auch in dieser Beziehung die Bemerkung HARNISCH's an, dass „die in Moosen und Mooren unserer Breiten vorkommenden Formen" — der Gattung *Nebela* — „ganz fehlen und Formen vorherrschen, die mir" — d.h. HARNISCH — „bislang noch gar nicht oder kaum zu Gesicht gekommen waren." Die von HARNISCH eingestandene Möglichkeit, dass die ostindischen Formen z.T. mit denen aus gemässigten Breiten nicht ganz identisch sind, geben wir zu; dies könnte aber natürlich nur durch ein eingehendes Studium der betreffenden Formen sichergestellt werden.

Vier der von HARNISCH beobachteten und relativ sicher bestimmten *Nebela*-Arten traten auch in unserem Material auf: *collaris, lageniformis, americana* und *crenulata* (= *dentistoma*), grösstenteils nicht in nur wenigen, sondern in Hunderten von Individuen. Einmal wurde eine Form beobachtet, welche der *N. tubulosa* jedenfalls nahe steht; *N. tenella,* bei HARNISCH nur 4 zweifelhafte Exemplare, fehlt in unserem Material. Ausserdem fanden wir von den uns schon aus Europa bekannten Arten: *N. militaris,* in vielen Proben, oft massenhaft; *tincta* ebenso, mit zu *collaris* und *flabellulum* konvergierenden Varianten; *galeata* f. *minor,* nur in einer Probe, aber in einer individuenreichen Population; *tubulata,* von uns früher zu *lageniformis* gerechnet, auf Grund eines Studiums grösserer Populationen später davon geschieden; *vitraea,* nur in einer Probe, zweifelhaft. Und schliesslich lieferte unser Material uns nicht weniger als 6 uns noch unbekannte, mit Sicherheit zu identifizierende Arten, von denen 3 soweit bisher bekannt auf der südlichen Hemisphäre beschränkt zu sein scheinen, nur noch von wenigen Fundstellen vorliegen, z.T. aber weit verbreitet sind. Es sind dies die folgenden Arten:

1. *N. bigibbosa.* Unsere an Individuen dieser Art reiche Probe vom Pangerango (Java, in 6°32′ südlicher Breite) ist die erste auf der südlichen Hemisphäre.

2. *N. caudata.* In Europa nur in Schottland gefunden, ferner in den Vereinigten Staaten, Canada, Brasilien, Bolivia, Peru, Sumatra und Australien.

3. *N. griseola.* Bisher beobachtet in Frankreich, Deutschland, Irland, Nordamerika und Australien.

4. *N. vas.* (Diese und die beiden folgenden Arten sind nur von der südlichen Hemisphäre bekannt, s. aber S. 246). Bisher gefunden in Südamerika (Peru, Brasilien, Kap Horn) und Polynesien (Hawaii, Fidschi-Inseln); von uns (noch unveröffentlicht): Neuseeland (3 Fundstellen), Ushuaia (Magelhaenstrasse) und Chili.

5. *N. certesi.* Bisher angegeben von Südamerika (Columbien, Kap Horn), Polynesien, Australien; von uns gefunden: Desolacion (Feuerland).

6. *N. martiali.* Bisher gefunden in Südamerika (Columbien, Kap Horn) Australien, Neuseeland, Polynesien; von uns: Ushuaia (s. oben).

Übersieht man die ganze Liste unserer *Nebela*-Arten im Vergleich mit den Arten dieser Gattung, welche PENARD in den Resultaten der British Antarctic Expedition (1911) aufzählt, so fällt die grosse Übereinstimmung damit sehr auf.

Von den 17 Stationen, wo diese Expedition auf Rhizopoden untersuchtes Material gesammelt hat, von denen 14 in den Tropen oder auf der südlichen Hemisphäre liegen, werden insgesamt 15 *Nebela*-Arten erwähnt, unter welchen *N. longicollis* bei uns fehlt. Wie aber Penard selber gesteht, ist diese Art ausserordentlich polymorph und von anderen (*americana, lageniformis, ?vitraea*) kaum zu unterscheiden. Dagegen fehlen die von uns gefundenen *N. americana, galeata* f. *minor, tubulata* und *vitraea* in den genannten Resultaten.

Von den übrigen Formen unseres Materiales besprechen wir noch kurz die folgenden, speziell in chorologischer Hinsicht.

1. **Bullinula indica** (s.S. 234). Diese aus Moosen von dem Himalaya 1907 von Penard zuerst beschiebene Form ist seither an den verschiedensten Orten, auch fossil in Torfmooren, wiedergefunden worden (Hoogenraad, 1933). Durch die British Antarctic Expedition wurde sie an nicht weniger als 14 von den insgesamt 17 Stationen angetroffen. Ihre ausserordentliche Seltenheit in unserem Material ist also einigermaassen befremdend, besonders weil es eine grosse und nicht leicht zu übersehende Form ist.

2. **Difflugia oviformis** (s.S. 222). Von Cash (1909) zuerst beschrieben von einer einzigen Fundstelle in Grossbrittannien und von Deflandre (1927) für einigen Orten in Frankreich angegeben, ist diese Art von uns wiederholt in unserem Faunengebiet beobachtet. Der Habitus der Schale und besonders die Struktur des Mundsaumes ist so charakteristisch, dass wir obwohl wir nur ein einziges Individuum entdeckten, dieses ohne Vorbehalt mit der genannten Art zu identifizieren wagen.

3. **Difflugia lucida.**

Eine leicht übersehene, aber wenn einmal bekannt ebenso leicht zu identifizierende Art. In den Resultaten der British Antarctic Expedition wird sie von 9 Fundstellen angegeben; bei Harnisch fehlt sie.

4. **Heleopera cyclostoma** (= *Averintzevia cyclostoma*). Wie S. 217 schon bemerkt wurde, haben wir diese Art zuerst für eine Form der var. *amethystea* von *Heleopera petricola* gehalten. Sowohl die ansehnliche Grösse als die eigentümliche Farbe und der Bau der Schale, endlich die nicht spaltenförmige, sondern breitelliptische Mundöffnung unterscheiden sie von der genannten Art und ihrer Varietät, vielleicht genügend um ihre Erhebung zu einer selbständigen Gattung zu rechtfertigen. Ausser an einigen Orten in Europa (Frankreich, Grossbrittannien) wurde sie bisher nur gefunden in Nordamerika (New Jersey, Canada).

5. **Cryptodifflugia compressa** (s.S. 225). Harnisch erwähnt zwei andere Arten dieser Gattung; auch in den Resultaten der British Antarctic Expedition wird diese Art nicht genannt. Dagegen giebt Playfair (1917) sie an für Australien (New South Wales); ferner wurde sie an einigen Orten in Europa beobachtet, von uns auch im niederländischen Faunengebiet. Bis auf eine wenig bedeutende Abweichung war die tropische Form identisch mit der niederländischen.

6. **Sphenoderia macrolepis** (s.S. 225). Diese uns noch unbekannte Art wurde von LEIDY (1879) zuerst beschrieben aus Nordamerika, später von WAILES gefunden an diversen Lokalitäten der britischen Inseln; an anderen Orten scheint sie bisher nicht beobachtet zu sein.

7. **Placocista jurassica** (s.S. 216, 230). Obwohl wir von der Identität dieser Form nicht in jeder Hinsicht überzeugt sind, zeigen die von uns beobachteten Individuen doch soviel Übereinstimmung damit, dass wir ihre Zugehörigkeit zu der genannten Art für sehr wahrscheinlich halten. Seit PENARD (1905) die Art zum ersten Male beschrieb, ist sie an verschiedenen Stellen in Europa gefunden; weiter ist sie bekannt für Nord- und Südamerika. Eine ihr nahestehende Form kennen wir aus Brasilien.

Werfen wir nun zum Schluss einen Blick auf die Gesamtheit der Arten der thekamoeben Rhizopoden, wie diese in den von ons untersuchten Proben vertreten sind und vergleichen wir diese mit den Artenkombinationen, wie sie in den Moosen höherer Breiten — soweit bekannt — auftreten, dann sehen wir, dass erstens — wie das auch in ähnlichem aussertropischem Material der Fall ist —, die Arten der Gattungen *Hyalosphenia* — mit Ausnahme nur von *H. subflava* — und *Amphitrema* samt und sonders fehlen. Dagegen ist die Hauptmasse der in unseren Proben vorkommenden Gattungen und z.T. auch der Arten genau die gleiche, wie sie an europäischen Moosfundstellen den sog. Waldmoostyp von HARNISCH darstellen; dies ist auch darum nicht zu verwundern, weil diese Assoziation das am wenigsten spezialisierte Stadium der in der Richtung der streng spezialisierten, typischen Hochmoorassoziationen gehenden Entwicklungsreihe darstellt, in deren letzteren die beiden letztgenannten Gattungen mit ihren typischen Arten dominieren. Abgesehen von dem Vorkommen einiger bisher nur auf der südlichen Hemisphäre gefundenen Arten und von immer auftretenden individuellen Variationen sind die Artenassoziationen unseres Materiales nahezu die selben wie diejenigen unseres eigenen europäischen Untersuchungsgebietes. Damit will natürlich nicht gesagt sein, dass jede Art aus dem tropischen Material an und für sich für 100% identisch ist mit der gleichnamigen aus höheren Breiten; wie schon hervorgehoben, würde das in jedem einzelnen Fall nur durch die gründliche, vergleichend-statistische Analyse eines umfangreichen Materiales zu entscheiden sein.

VI. ÜBERSICHT DER BEOBACHTETEN GATTUNGEN UND ARTEN.

Arcella arenaria, ?artocrea, spec.
Centropyxis aculeata, cassis, constricta, discoides, ?ecornis, ?minuta, ?orbicularis.
Bullinula indica.
Trigonopyxis arcula.
Difflugia ?globulosa, lobostoma, lucida, oviformis.
Heleopera cyclostoma, petricola, ?picta, rosea.
Hyalosphenia subflava.

Nebela americana, bigibbosa, caudata, certesi, collaris, dentistoma, flabellulum, galeata f. *minor, griseola, lageniformis, martiali, militaris, tincta, vas, ?vitraea, tubulata,* spec.
Quadrula plicata, scutellata, ?symmetrica, tropica.
Phryganella hemisphaerica, ?nidulus, spec.
Cryptodifflugia compressa.
Euglypha acanthophora, ciliata, ?compressa, cristata, ?laevis, ?rotunda, spec.
Assulina muscorum, seminulum.
Sphenoderia fissirostris, lenta, macrolepis.
Placocista jurassica, ?spinosa.
Corythion dubium.
Trinema complanatum, enchelys, lineare.

VII. LITERATURLISTE.

(Die Namen der Autoren sind alphabetisch, ihre Arbeiten chronologisch geordnet).

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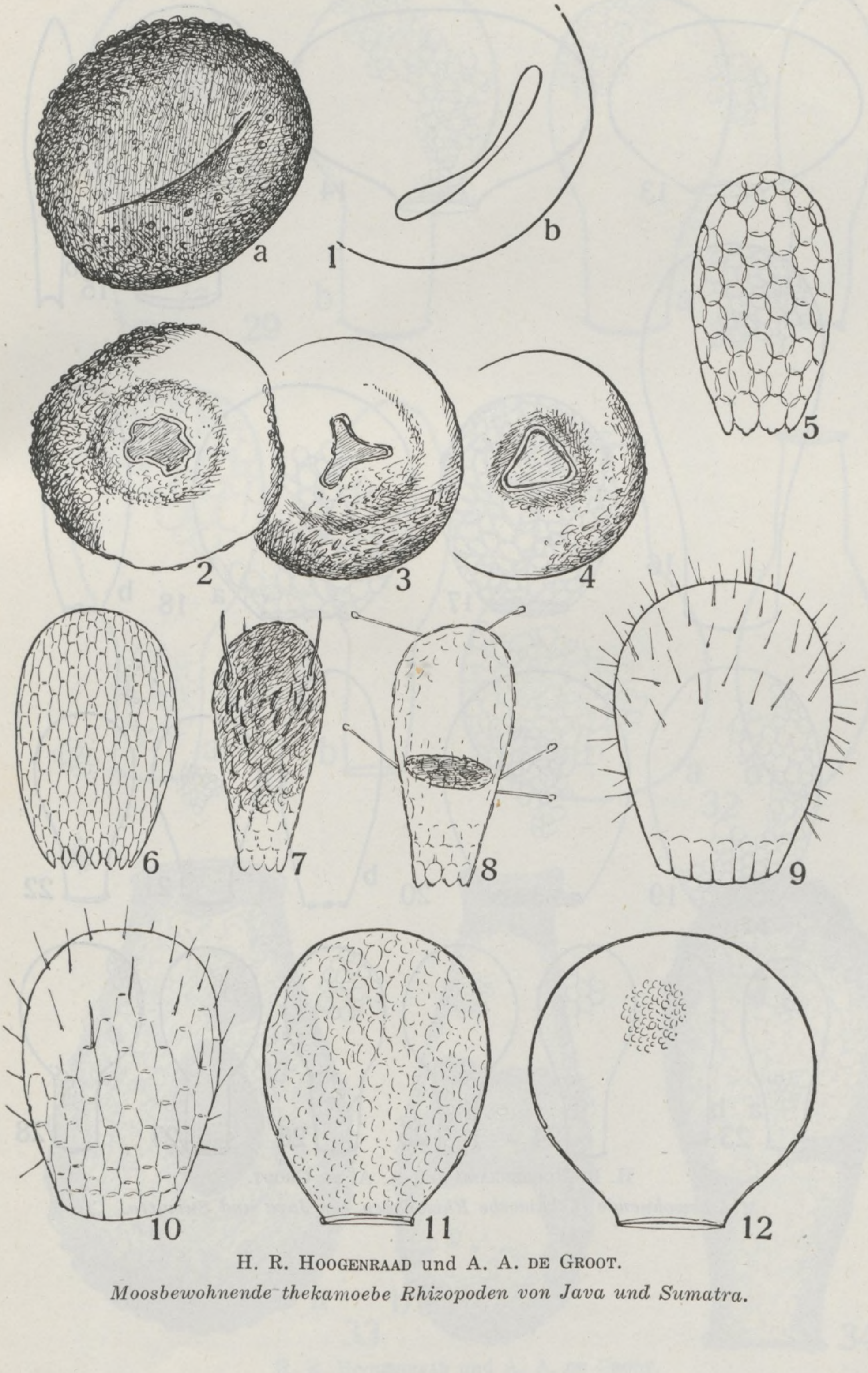
VIII. FIGURENERKLÄRUNG.

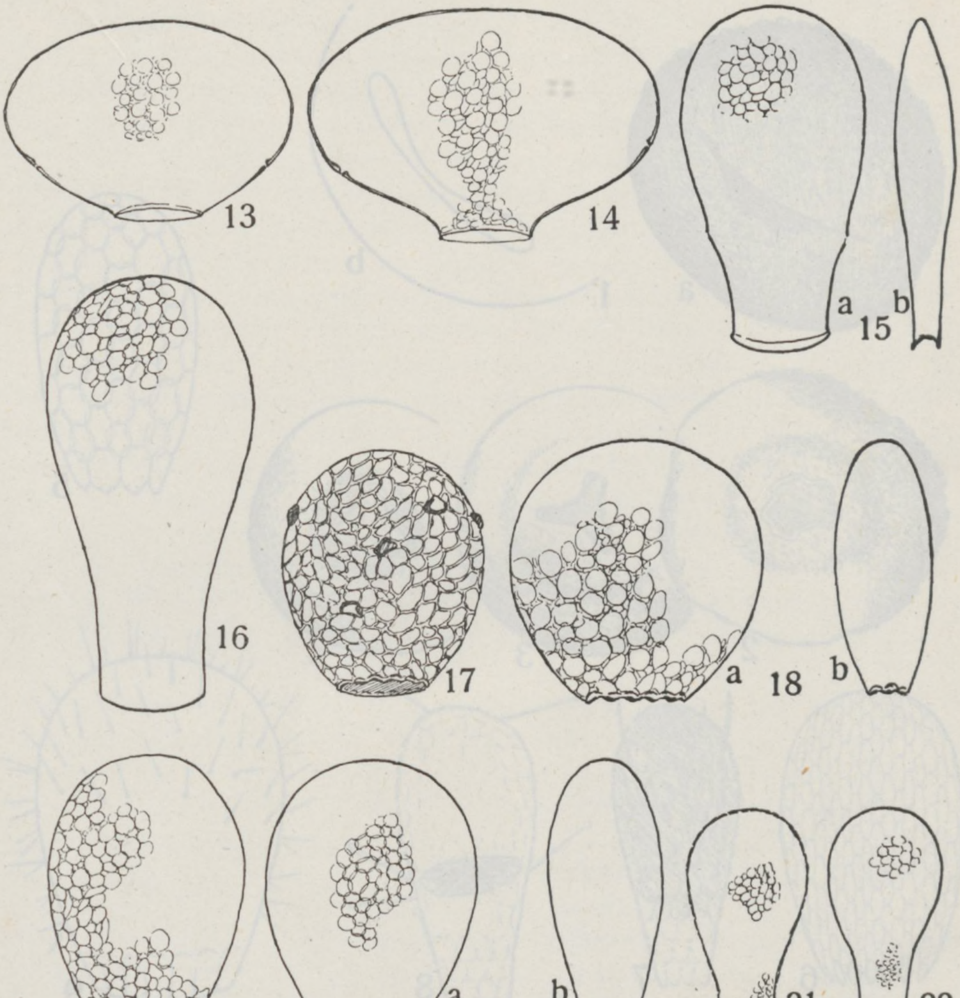
(Für Grössenangaben sehe man den Text nach).

Figurnr.	Name der abgebildeten Art	Probenr.
1a	*Bullinula indica;* 1b dasselbe Exemplar, Umriss der Mundöffnung in einer anderen Lage	XIV
2 - 4	*Trigonopyxis arcula*	VIII
5	*Euglypha ?rotunda*	XIV
6	„ spec.	II, XIII
7	„ *acanthophora*	V
8	„ spec.	IX
9, 10	*Placocista jurassica*	XI
11	*Nebela tincta*	VI
12	„ *tincta-flabellulum*	VIII
13, 14	„ *flabellulum*	VI, VIII
15	„ *galeata* f. *minor*	XI
16	„ *americana*	IV
17 - 20	„ *dentistoma*	VI, VIII, IX, X
21 - 23	„ *militaris*	XIV
24 - 28	„ *tubulata*	XIV

Figurnr.	Name der abgebildeten Art	Probenr.
29	*Nebela lagerformis* ?var. *cordiformis*	III
30 - 32	„ *lageniformis*	X, XIII
33 - 36	„ *bigibbosa*	III
37 - 41	„ *martiali*	IX
42, 43	„ *certesi*	XI
44, 45	„ *certesi*	Neuseeland, Feuerland
46 - 49	„ *vas*	VIII, XIII
50 - 52	„ *griseola*	IX, XIV
53 - 55	„ *caudata*	IX, XI, XIV
56	*Arcella artocrea* PENARD	IX
57	„ spec.	VIII
58, 59	*Quadrula plicata*	X
60 - 62	„ *tropica*	III, IX
63	„ *?symmetrica*	IX
64 - 66	„ *scutellata*	II, XIII
67	*Difflugia lucida*	III
68	„ *oviformis*	IX
69a	*Heleopera cyclostoma;* 69b Mundöffnung schief von unten ...	V, XIII
70, 71	*Heleopera petricola*	VI, XIII
72	„ spec.	XIII
73	„ *cyclostoma*	XIII
74	„ *petricola* var. *amethystea*	XIII
75	„ spec.	XIV
76	*Centropyxis discoides*	XIII
77	„ *cassis*	IX
78	„ *?orbicularis*	X
79, 80	„ *constricta*	X
81	„ *?constricta*	VIII
82	„ *?minuta*	X
83 - 91	*Trinema complanatum-enchelys-lineare*	IX
92, 93	*Sphenoderia macrolepis*	IX
94 - 97	„ *fissirostris, ?lenta*	XI, XIV
98, 99	*Cryptodifflugia compressa*	IX
100	*Hyalosphenia subflava*	IX



H. R. HOOGENRAAD und A. A. DE GROOT.
Moosbewohnende thekamoebe Rhizopoden von Java und Sumatra.



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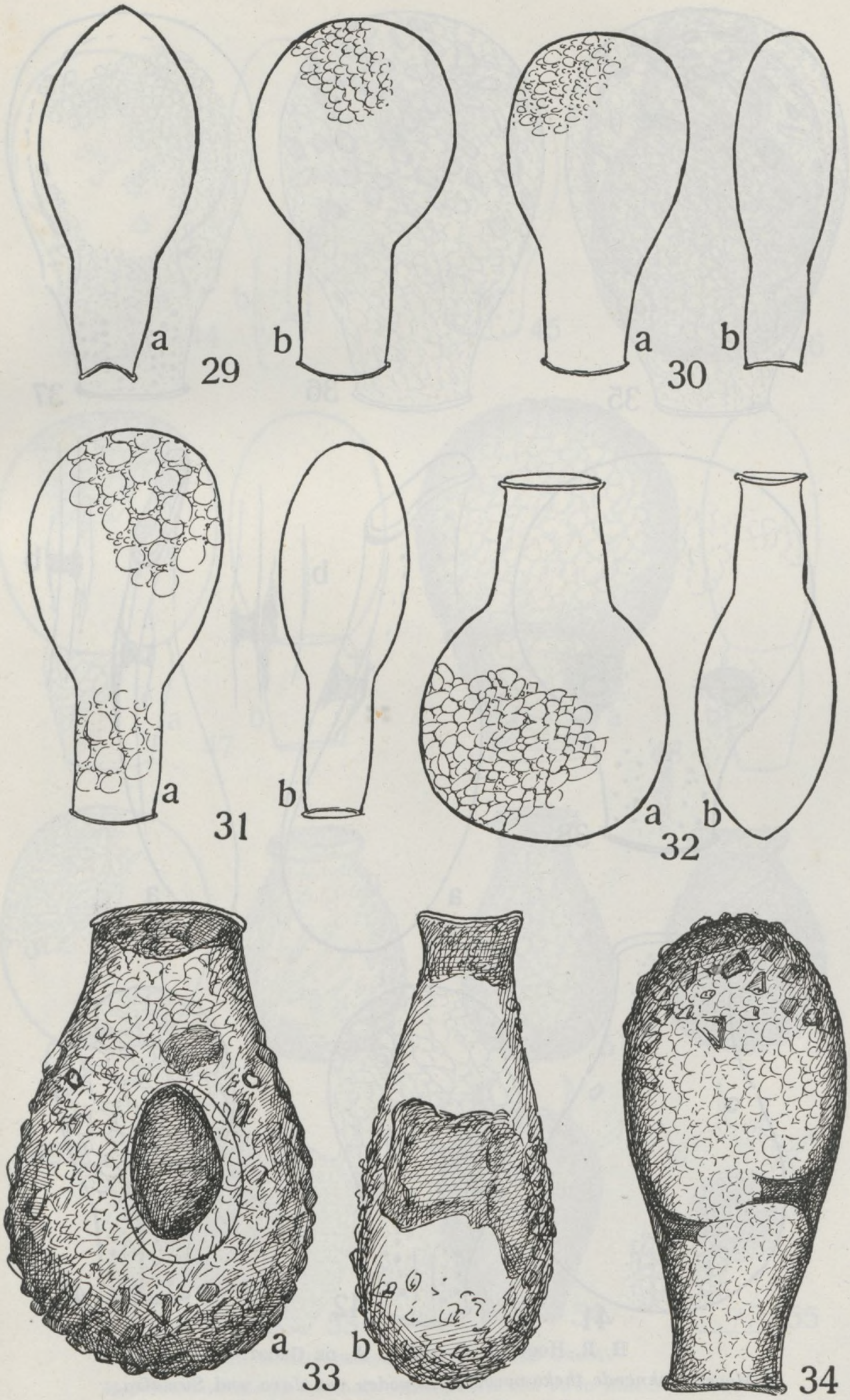

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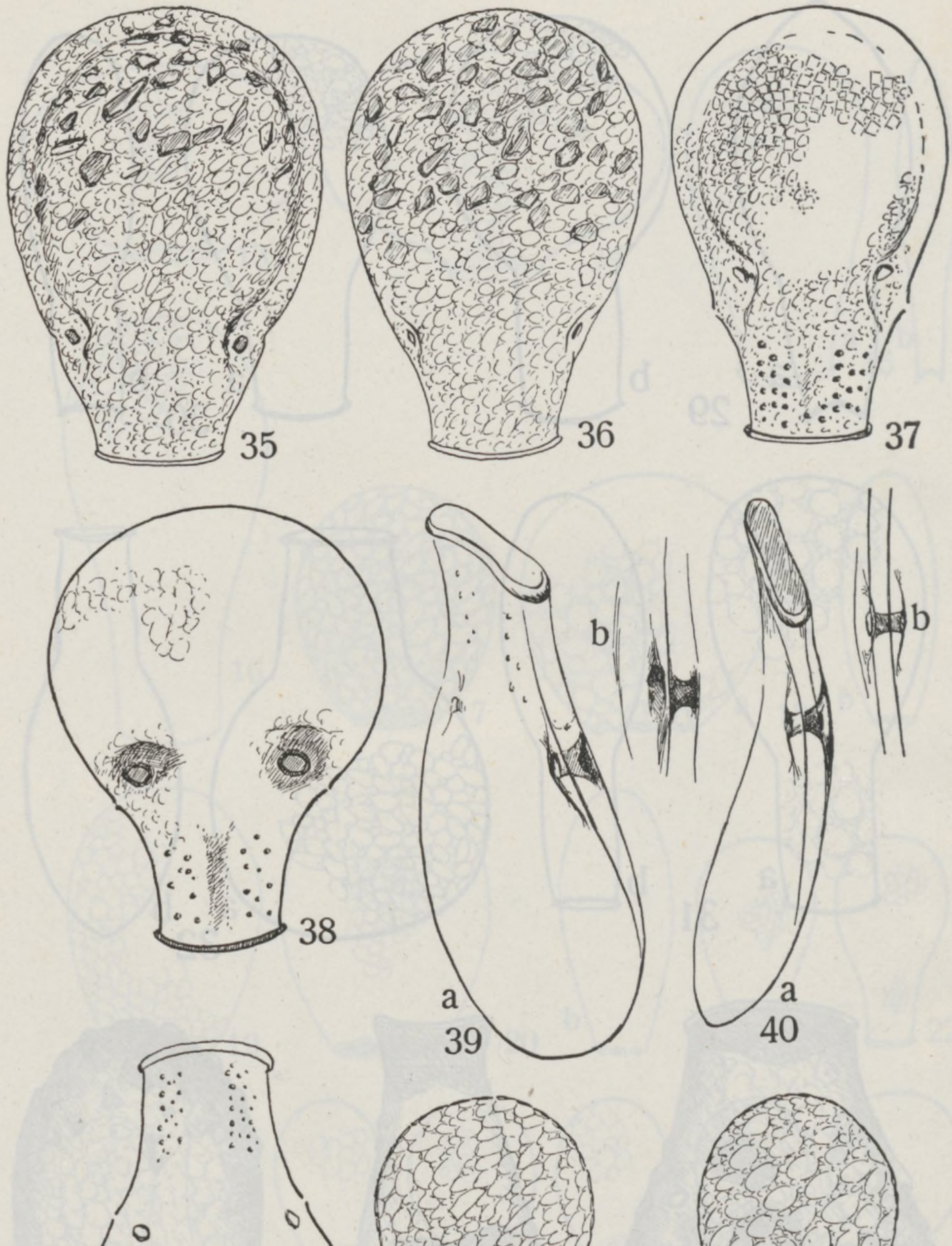

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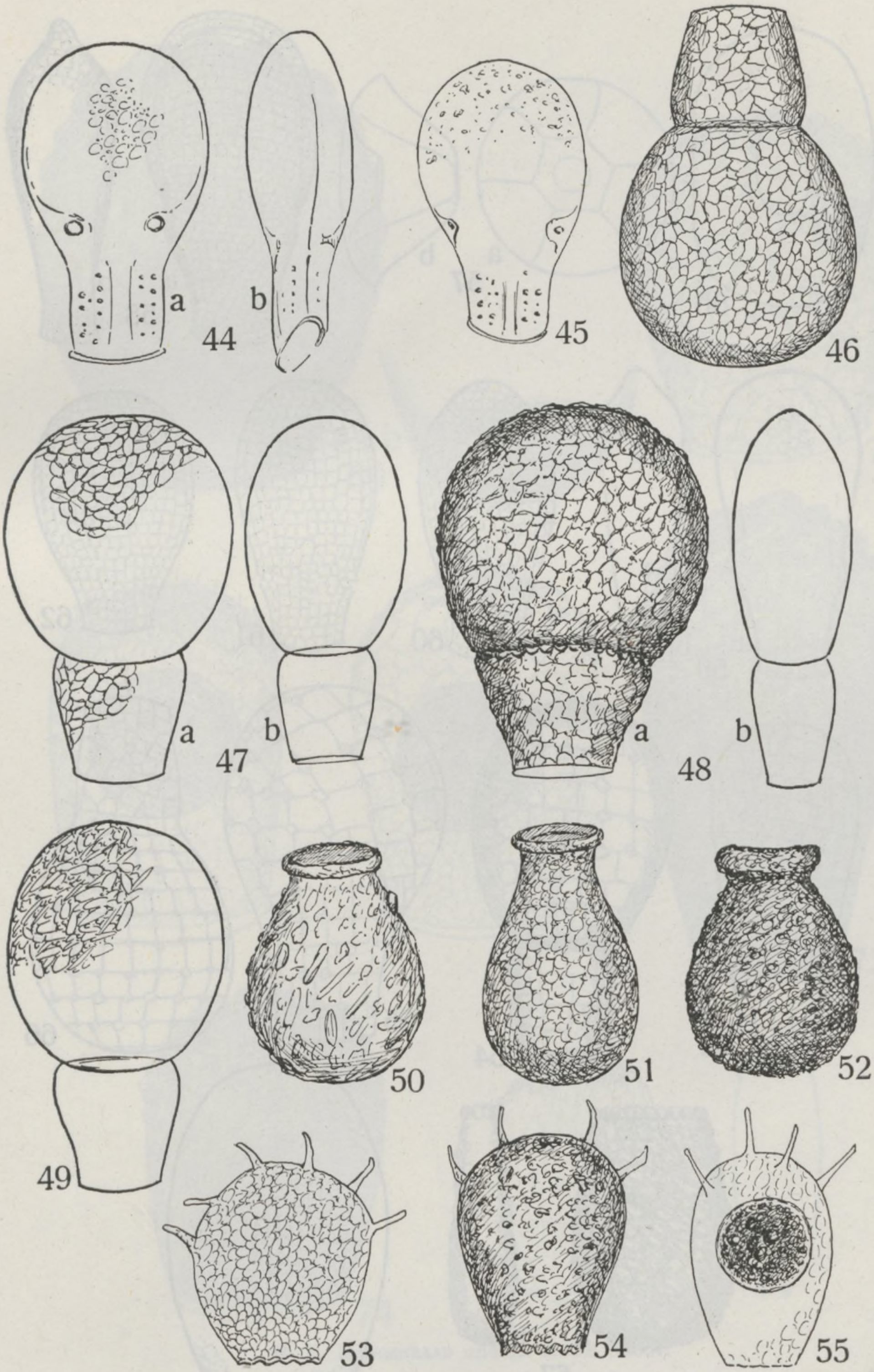
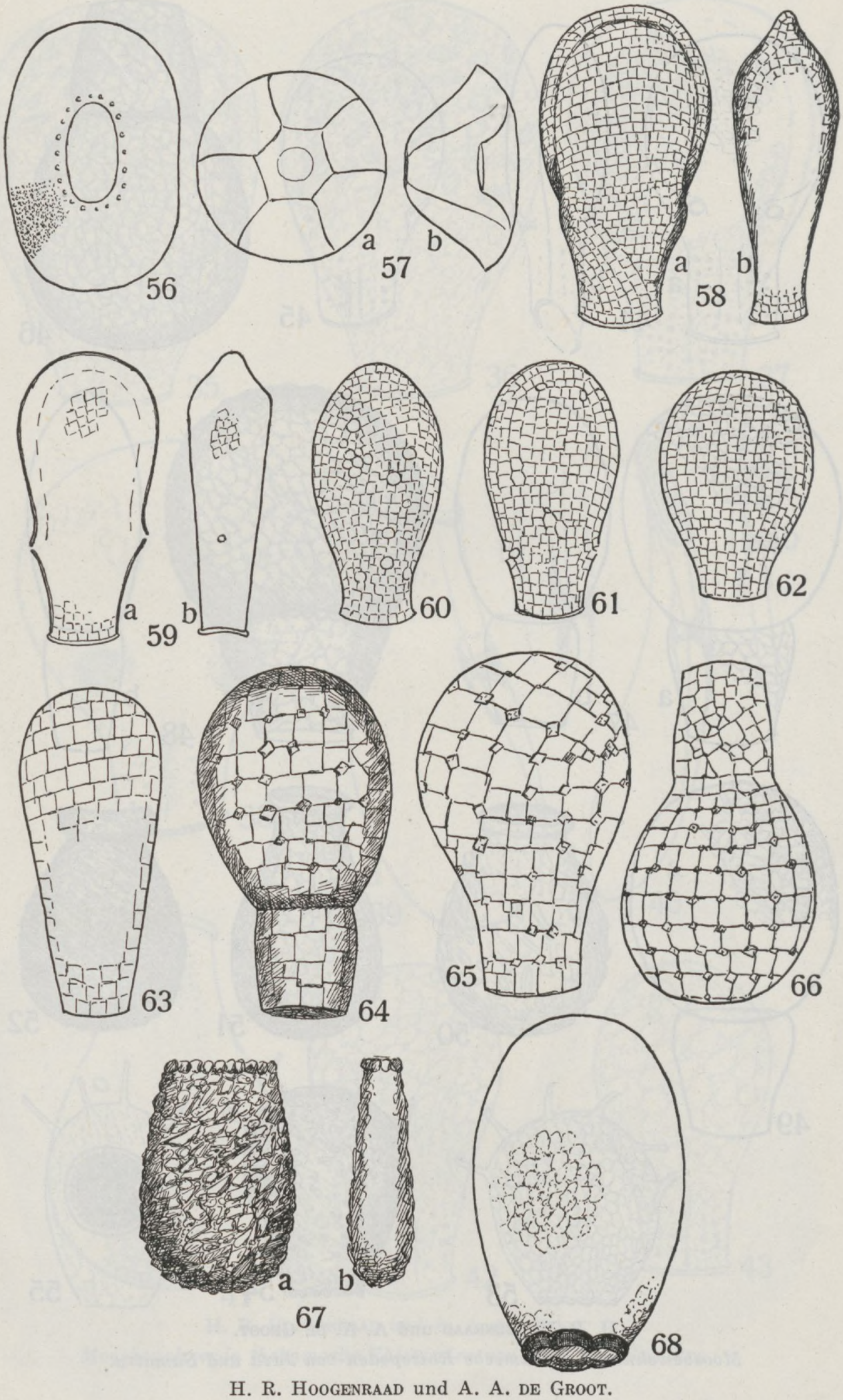


H. R. HOOGENRAAD und A. A. DE GROOT.

Moosbewohnende thekamoebe Rhizopoden von Java und Sumatra.



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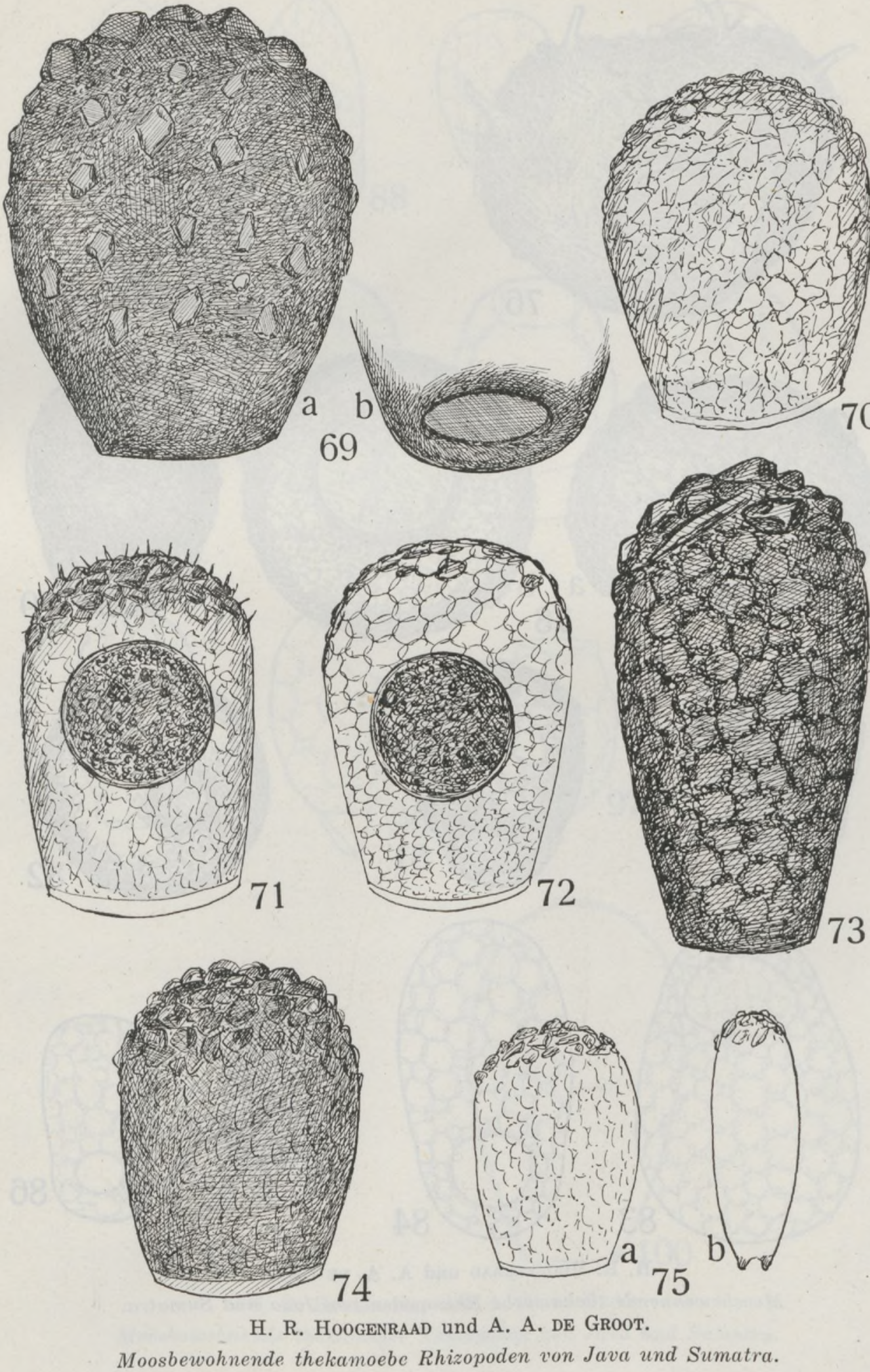

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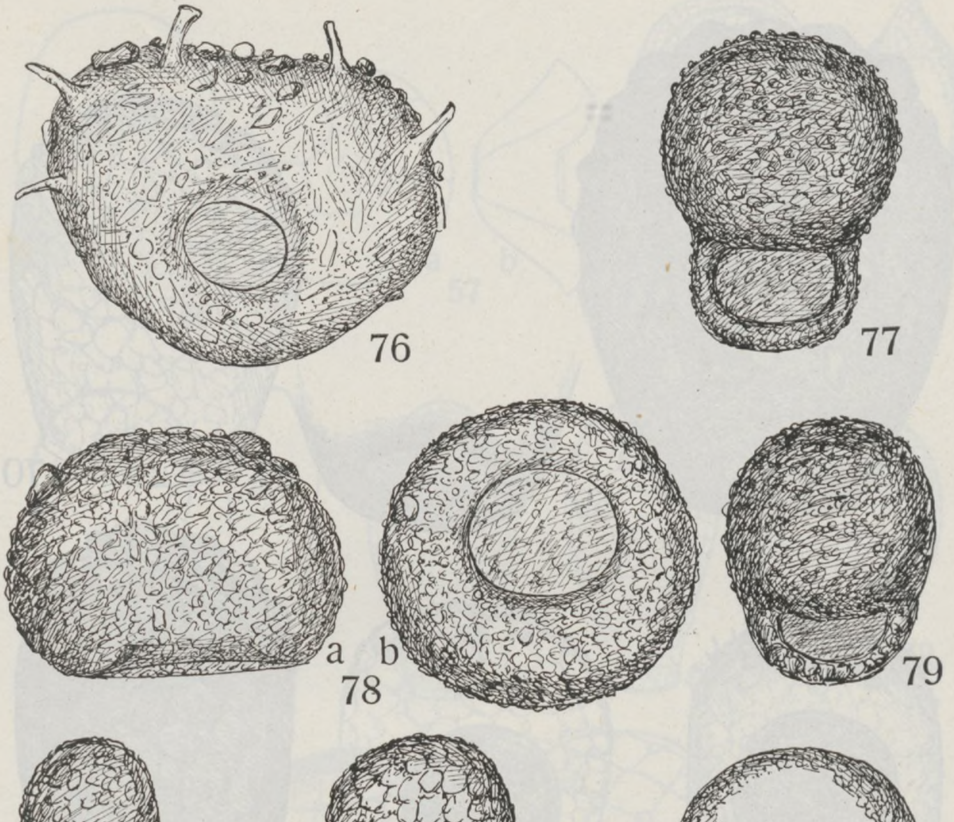

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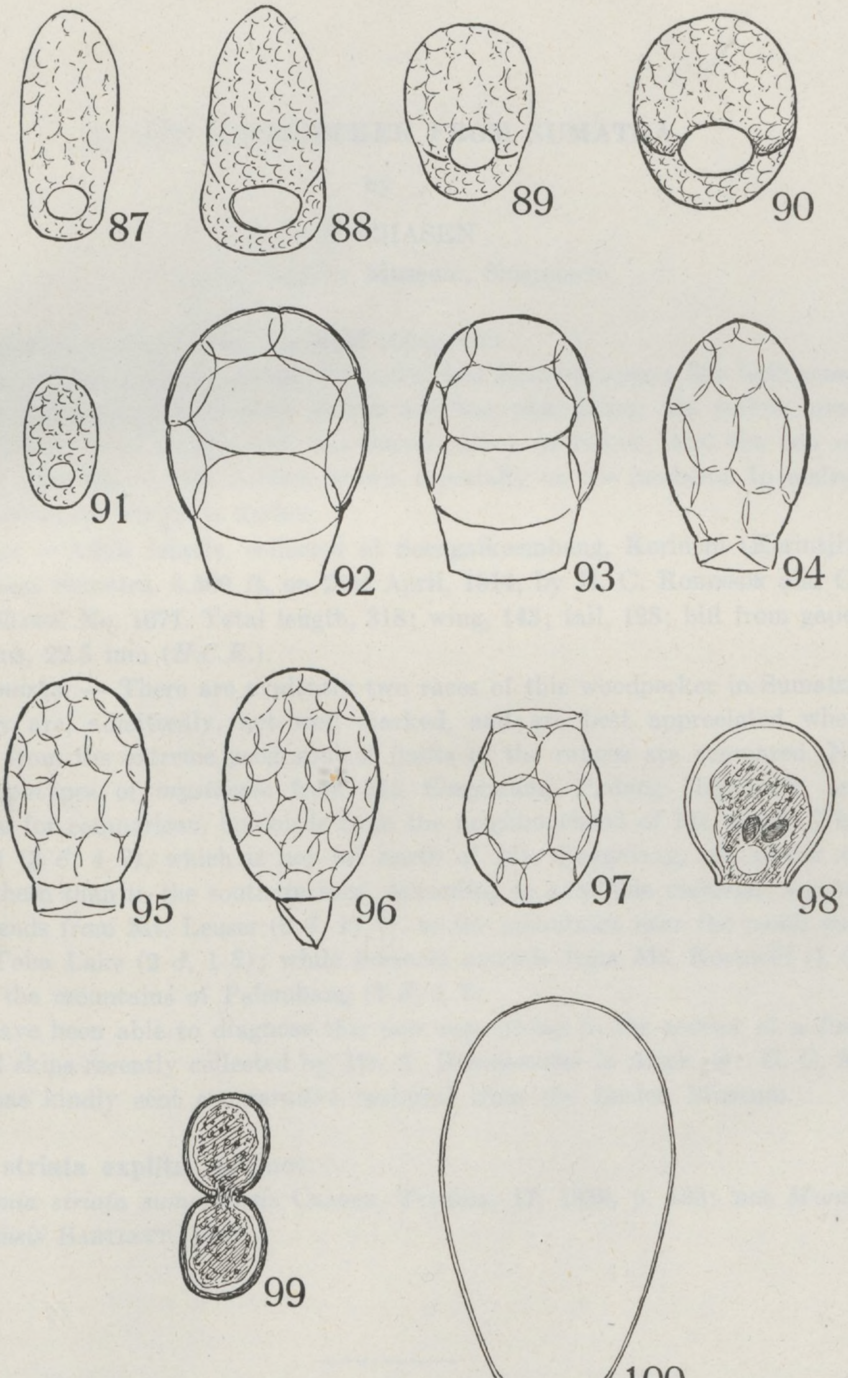


H. R. HOOGENRAAD und A. A. DE GROOT.

Moosbewohnende thekamoebe Rhizopoden von Java und Sumatra.

A NEW WOODPECKER FROM SUMATRA

by

F. N. CHASEN

(Director, Raffles Museum, Singapore).

Chrysophlegma flavinucha korinchi subsp. nov.

Like *C. flavinucha mystacale* of Central and North Sumatra, but both sexes with the upper parts of a more golden and less pale green; the yellow crest rather deeper, more golden and less lemon-yellow in colour; and the top of the head more tinged with reddish brown, especially on the forehead. In males, the yellow malar stripe is darker.

Type. — Adult female, collected at Soengaikoembang, Korinchi (Kerintji), South-West Sumatra, 4.500 ft, on 21st April, 1914, by H. C. Robinson and C. Boden Kloss. No. 1071. Total length, 318; wing, 143; tail, 128; bill from gape, 37; tarsus, 22.5 mm (*H.C.R.*).

Remarks. — There are evidently two races of this woodpecker in Sumatra but they are, admittedly, not well marked, and are best appreciated when females from the extreme geographical limits of the ranges are compared. No exact topotypes of *mystacale* from Mt. Singgalang, Padang Highlands, are available for comparison, but birds from the neighbourhood of Mt. Ophir (Talakmau) (3 ♂, 4 ♀), which is not far north of Mt. Singgalang, are nearer to the northern than to the southern race. According to available material, *mystacale* extends from Mt. Leuser (3 ♂, 11 ♀), to the mountains near the north end of the Toba Lake (2 ♂, 1 ♀); while *korinchi* extends from Mt. Korinchi (1 ♂, 7 ♀) to the mountains of Palembang (1 ♂, 1 ♀).

I have been able to diagnose this new race owing to the receipt of a fine series of skins recently collected by Mr. A. Hoogerwerf in Atjeh. Dr. G. C. A. Junge has kindly sent comparative material from the Leiden Museum.

Munia striata explita nom. nov.

Munia striata sumatrensis Chasen, Treubia, 17, 1939, p. 183: not *Munia sumatrensis* Bartlett, 1888.

NOTES ON SOME JAVAN BIRDS

by

F. N. CHASEN

(Director, Raffles Museum, Singapore).

Serinus estherae orientalis subsp. nov.

Like *S. e. estherae* from West Java, but the bill considerably smaller (shorter and less robust) in both sexes, the exposed culmen measuring 9.1 - 10 mm against 10.4 - 10.8 mm in males, and 9.3 - 9.6 against 10.1 mm in females of *estherae*. The differences seem small when expressed in figures, but they are striking when the skins are compared: they are also minimised by one male of the western race (Poentjakpas, culmen 9.1 mm) in which the bill is less robust than in exact topotypes from Mt. Pangrango: nevertheless, even in this bird the distinction between the two races is still obvious, especially when the bill is viewed from above.

Type. — Adult male, collected on Gng. Ajekajek, Tengger mountains, East Java, about 2.300 m, on 3rd July, 1939, by A. C. V. van Bemmel. Buit. Mus. No. 12412. Wing, 68.5 mm.

Specimens examined. — Six males and two females, all from the Tengger mountains (Gng. Iderider, and Gng. Ajekajek, 2.300 - 2.400 m); compared with three males and two females of the typical race, which with the exception of one male from the Poentjakpas, 1450 m, near Buitenzorg, are all exact topotypes from Pangrango.

Colour. — A detailed comparison of the skins shows that in the males of *orientalis* the yellow of the breast is not quite so bright as in the Pangrango examples of *estherae:* the blackish markings on the flanks seem slightly broader; the yellow malar patch is less extensive; and the yellow wing bars are of a paler, less golden yellow. Two specimens of *orientalis* have a small white patch around the eyes, and covering the lores: this white area is less marked in the other four skins which are about as in the western birds in this respect, that is to say they have a narrow, ill-defined whitish ring round the eye. But the males of *orientalis* and the single male of *estherae* from the Poentjak are alike in colour. Turning to females, one *orientalis* is entirely without yellow on the underparts, but otherwise females of the two races are very much alike. It is doubtful if the differences mentioned above are of racial significance, and all are possibly due to age, season, or individual variation, but in view of the rarity of the species in collections it seems worth recording observed differences even on the small series available.

Wings. — ♂ 68, 68.5, 69, 69, 69, 69.5; ♀ 67, 69 mm. The skins of the typical race before me measure, ♂ 67, 70, 70; ♀ 69, 71 mm.

Remarks. — *Serinus estherae* was described from the high level of 6.000 ft. on Mt. Pangrango, a volcano overlooking Buitenzorg from the south, in West Java, and I am not aware of any published records of its occurrence in Java elsewhere than on the mountains of the western part of the island.

The recent discovery of the species on the Tengger mountains in *East* Java by Mr. A. C. V. VAN BEMMEL of the Zoological Museum, Buitenzorg, therefore marked an interesting extension of range.

It was, of course, not unexpected to find that the eastern birds differed from western topotypes in some degree. *S. e. orientalis* is not a well-marked subspecies, but judging by the material before me the slight difference between it and the typical race is constant.

According to a recent observation made by Mr. M. A. LIEFTINCK a form of the species also exists on Mt. Telomojo, south of Semarang in Central Java, but no specimens from this region are yet available.

The third form of this species is *S. e. ripleyi* CHAS. (Treubia, 17, 1939, p. 137), recently described from Mt. Leuser, Atjeh, North Sumatra. Compared with the Javan forms it is rather darker on the upper parts, and shows more yellow in the plumage in both sexes. With a culmen of 8.1 - 8.8 mm it has an even smaller bill than *orientalis,* but otherwise the size is about as in the Javan races.

For the loan of two pairs of *S. e. estherae* from Pangrango I am indebted to Dr. MAX BARTELS: the other material discussed above belongs to the Zoological Museum, Buitenzorg.

Dicaeum sanguinolentum (TEMM.).

The exact type locality of the eastern race, *D. s. ablutum* ROB. and KL. (Journ. Fed. Malay States Mus., XI.1923, p. 57) is Tamansari, on the Idjen Massif, near Banjoewangi in the *extreme east* of Java.

In 1929, BARTELS and STRESEMANN (Treubia, XI, p. 142), thought that the validity of the race needed confirmation: RENSCH (Mitt. Zool. Mus., XVI, 1930, p. 539) accepted it for Bali, but his material consisted of one juvenile only. The types of *ablutum* (male and female) are now not available to me in Singapore, but I find no difficulty in separating a male from Tamansari from nine males of the typical race collected on the mountains of West Java (Tjiomas; Tjibodas; Garoet). The eastern bird is paler on the chin and throat, which are mixed white and buff in colour, and not deep buff, or tinged with red as in the western race. Other points of difference are that the *ablutum* male has the breast less solidly red; the flanks and under tail coverts whiter and less deeply tinged with yellowish buff; and the black ventral stripe narrower. A single male from the Tengger mountains is somewhat intermediate in its characters, but on the balance of appearance I should put it with *ablutum.*

Turning to females, no material from Tamansari is avialable. One specimen from the Tengger mountains is much paler below than two from Mts. Karang and Pangrango in West Java, but I do not think it could be separated from

three other females from Garoet and Tjisaroea near Buitenzorg: all have red rumps. It is therefore possible that in Java true *ablutum* is restricted to the extreme east of the island.

A male and three females from a most interesting intermediate locality, Kedoe in Middle Java are, unfortunately, scarcely worth discussion for they have been preserved in formalin, which like alcohol and liquid preservatives containing arsenic will, in spite of the assertions made by many collectors, often alter the colours of birds (and mammals) in a very deceptive manner, for the specimens often present, finally, a very "natural" appearance. As it stands this Kedoe male, like that from the Tengger mountains, is intermediate in appearance. It has the pale flanks and under tail coverts of the eastern race, but otherwise is hard to separate from the western race.

Mr. A. C. V. van Bemmel has called my attention to the indisputable fact that whereas females of *D. s. sanguinolentum* have a red rump, young males have no red on the upper parts, and he therefore quite reasonably suggests that the "female" type of *ablutum* is really a young male; and that Rensch's so-called juvenile male is really a female. This may be so, but it must be remembered that in some other races of *sanguinolentum* (e.g. the continental *ignipectus* and *dolichorhynchum,* and the Bornean *monticolum*) the females have no red rump: perhaps *ablutum* is the same. Further investigation is needed.

Aplonis minor minor (Bp.).

A male of this form taken at Goeboekklakah at the foot of the Tengger mountains, at an altitude of about 1.080 metres, and forwarded by Mr. A. C. V. van Bemmel seems to be the first record of the species from East Java, although of course its occurrence there was to be expected.

Butreron capellei (Temm.).

The type locality of *Columba capellei* Temminck is "Java", but the species is either very rare, or local, in that island and I know of no records other than the few well-known old references. Dr. Max Bartels has written to me confirming that the species is still not represented in the large Bartels collection of Javan birds. It is therefore interesting to make a detailed comparison of a pair of Javan birds (a male from Madjingklak, near Tjilatjap, on the south coast of West Java, 1st February 1921 and a female from Kalipoetjang near the same place, 16th February, 1923) lent to me by Dr. L. van der Pijl, with material from Borneo and the Malay Peninsula although, of course, in the absence of a longer series of Javan birds it may well be that the observed differences are only individual in character. Dealing first with colour I cannot separate males from various parts of the Malay Peninsula, Sarawak and British North Borneo; in these places the colour of the crown is variable, ranging from pure olive to clear grey, but otherwise the colour is fairly constant, variation seeming to depend mostly on the freshness of the plumage at the time of death, and the state of the skin, the best specimens being slightly paler with a grey

bloom, the greasier skins somewhat greener. From these skins the single Javan male stands out by reason of its slightly darker, browner, less yellowish breast patch, on the sides of which the vinaceous flush is, perhaps, also rather more pronounced than in the other males: the crown is grey as in the minority of males from elsewhere.

The female from Java seems not to differ in any way from some females from Borneo and the Malay States, which are also rather variable in the colour of the crown and sides of the head. As in the case of the male, the Javan female matches the greyest specimens.

The following measurements in millimetres, including some taken from a manuscript carefully prepared in the British Museum by the late H. C. ROBINSON, are available for comparison.

Locality	Number of specs.	Sex	Wing-range and average	Length of bill from gape and average	Height of bill at base and average
B. c. magnirostris.					
Malay Pen.	40	♂	192–205 (197)	30.3–38 (33.7)	10.5–12.9 (11.6)
„	9	♀	189–210 (199)	31.4–35 (34.2)	10.2–11.5 (10.8)
Borneo	8	♂	192–203 (196)	32.8–37 (35.3)	10–11.5 (11)
„	7	♀	190–198 (194)	30–37 (34.1)	10.2–11.7 (11)
Palembang, Sumatra	3	♂	192–199 (196)	32.5–32.6 (32.5)	10.4–11.1 (10.7)
„	2	♀	191–199 (195)	33–35.8 (34.4)	11–11.3 (11.1)
B. c. capellei.					
Lampongs, Sumatra	1	♀	189	29.8	9.8
Java	1	♂	189	33.2	9.5
„	1	♀	187	33.1	9.5

The figures show that the only marked distinction in size throughout the range lies in the more slender bill of the typical (Javan) subspecies, and this more noticeable when skins are compared than the measurements suggest. This difference was noticed by SCHLEGEL as long ago as 1873 (Mus. Pays-Bas, Columbae, p. 58). The specimen from the Lampongs in South Sumatra is fully adult, and as is sometimes the case with Lampongs subspecies it is best referred to the Javan and not the Sumatran race.

Arborophila javanica (GMEL.).

There is an error on page 2 of "The Handlist of Malaysian Birds" (1935), that needs notice. In a late page-proof re-arrangement of *Arborophila* I linked a number of Malaysian forms together under the name of *brunneopectus* to which, previously, I had referred *campbelli* only, but unfortunately I did not notice that *javanica* has priority of date over *brunneopectus*, all reference to which should therefore be expunged from the Malaysian list.

A NEW RHIZOECUS SPECIES

by

Dr. J. G. BETREM

(Malang).

By the courtesy of the head of the "Instituut voor Plantenziekten" at Buitenzorg I received for identification a mealy bug on the tubers of *Amorphophallus variabilis*. As it is obviously a new species, it is described here.

Rhizoecus amorphophalli nov. spec.

Adult female. Small coccids, body long oval. Wax cover and colour unknown.

Taxonomic characters. Antennae rather short with 6 segments, the apical segment with three thick curved bristles, also the penultimate segments with such a bristle. Legs rather short, length of femur III 79 - 80 %, average 77.2 %, of that of tibia III; length of tibia III 66 - 74 %, average 70.5 %, of that of tarsus III; length of femur II 63 - 70 %, average 65.4 %, of that of tibia II; length of tibia II 83 - 88 %, average 85.7 %, of that of tarsus II; length of femur I 64 - 73 %, average 69.1 %, of tibia I; length of tibia 83 - 85 %, average 83.9 %, of tarsus I.

Claws long and slender without denticle: Digituli distinct, knobbed at the end; tarsal digituli not observed. Tibiae at the inner sides ending by two strong spurshaped spines. Legs without pores. Mentum normal, one? segmented. Spiracles small, not abnormal. Oral and anal osteoli present without distinct lips. Anal ring present, with six strong setae, the latter almost as long as the longest seta on the anal lob. No pores on the ring as in *Pseudococcus,* but a rather uneven areolation with large areoles. Cerari not developed. Anal lobes not very distinct, each with three long well developed setae. Body setae slender and thin rather scattered, not very long. Cerores of different size and shape. Scattered on the derm are small somewhat triangular, ? trilocular pores. Tubular pores mostly absent, very rarely some on the apical segments. Genacerores present on three sternites near the vulva. Large trilocular cerores on the derm as indicated in the figure. They exist of three tubular ducts, which are spirally twisted round each other. The entrances of these ducts are rising above the derm. The middle of two sternites of the abdomen possesses a conical structure bearing at the end some areolation. No ventrolabia.

Types in the collection of the Institute for Plantdiseases at Buitenzorg and in the collection of the Research Station "Midden- and Oost-Java" at Malang.

Distribution and foodplant: Found on tubers of *Amorphophallus variabilis* in "'s Lands Plantentuin" at Buitenzorg.

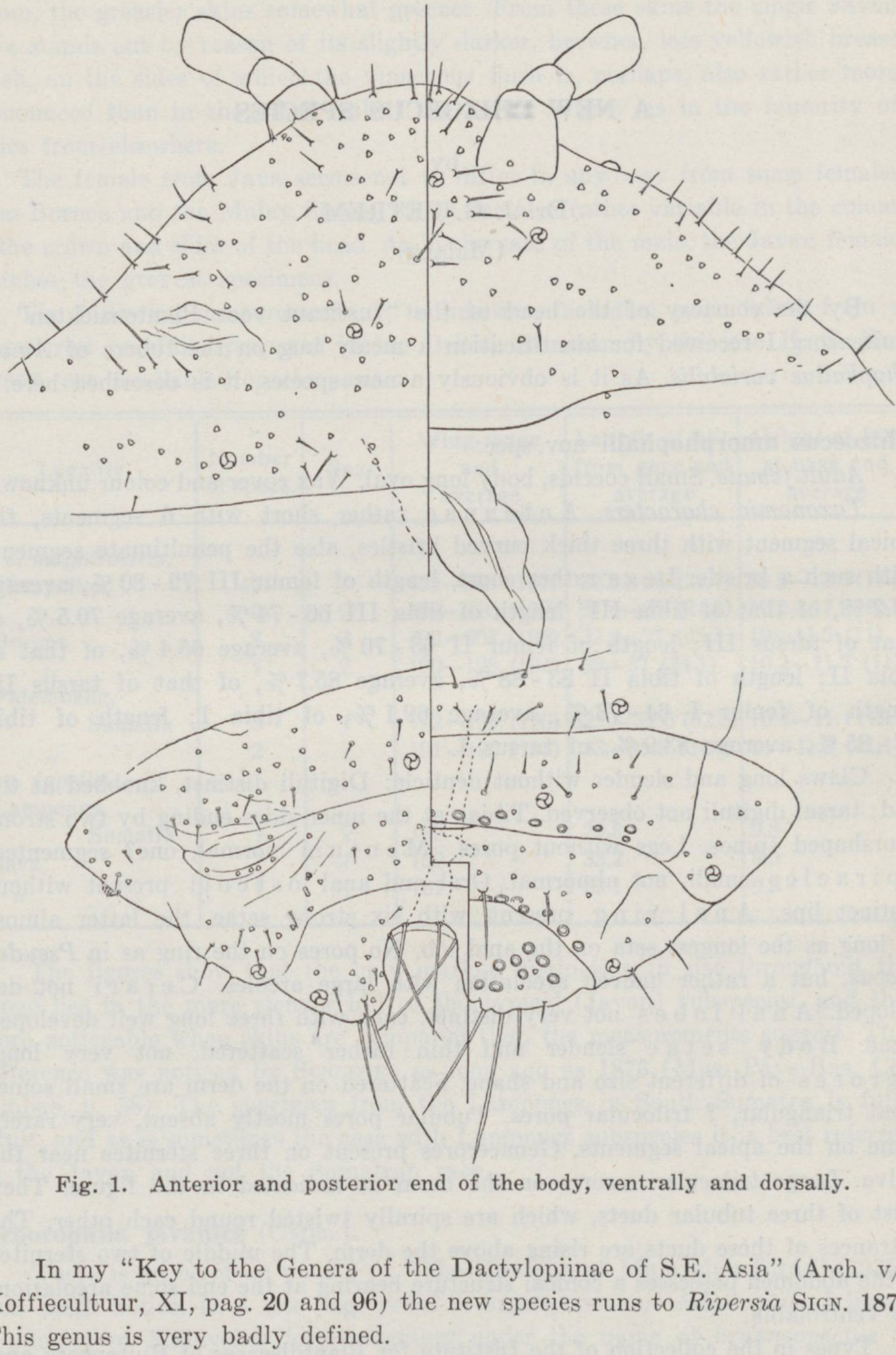


Fig. 1. Anterior and posterior end of the body, ventrally and dorsally.

In my "Key to the Genera of the Dactylopiinae of S.E. Asia" (Arch. v/d Koffiecultuur, XI, pag. 20 and 96) the new species runs to *Ripersia* SIGN. 1875. This genus is very badly defined.

In the year 1926 MORRISON mentioned the following: "The genus *Ripersia*, as now accepted, does not contain a well defined, homogeneous group of species, but instead is little more than a dumping ground for species of mealybugs

having 6-segmented antennae and living on Gramineae, or on the roots of other plants" (Jrl. Agr. Res. XXXIII).

Since then our knowledge about this genus has not much increased, because the genotype (typus generis) has not been found again since its description in the year **1857**.

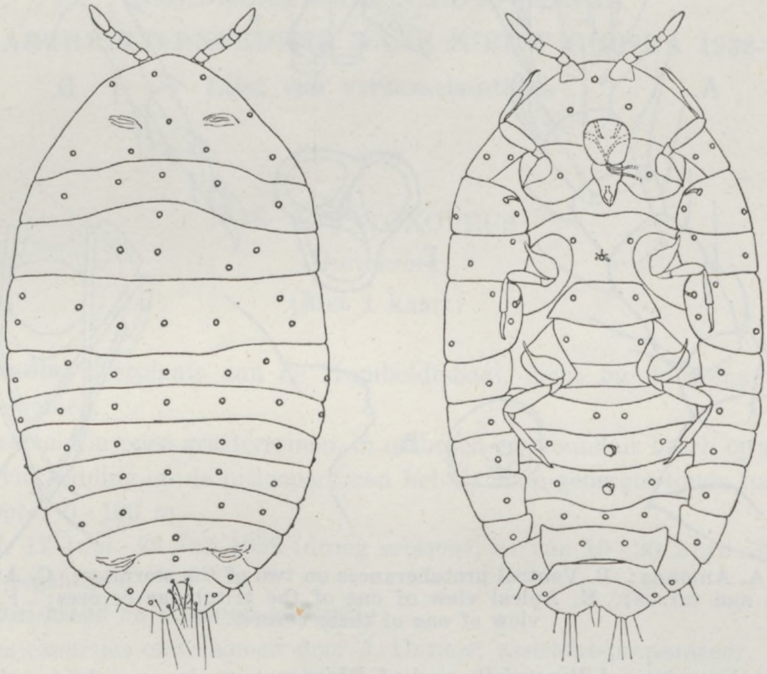


Fig. 2. **Habitus; the places of the large tritubular cerores are indicated by circles; also the ventral protuberances on two of the sternites.**

Some descriptions, however, of new genera or redescriptions of insufficiently described related genera show a way out to separate some groups of species from the old genus *Ripersia*.

The related genera about which I am informed are: *Rhizoecus* Kunckel 1878 (Leonardi Mon. Coccin. Ital. p. 424, 1920); *Mizococcus* Takahashi (Phil. Jr. Sc. XXXVI, p. 336); *Antoninella* Kiritshenko 1938 (Konowia XVI, p. 233); *Cryptoripersia* Ckll 1899 (Ferris: Calif. spec. mealy bugs, p. 73, 1918; Ferris: Coccidae of S.W. Un. St., p. 33, 1920); *Ripersiella* Tinsley 1899 (Morrison: Pr. Un. St. Nat. Mus. n. 2407, v. 60, art. 12, p. 54 - 55, 1922).

The genera *Mizococcus* and *Antoninella* have no falciform, thick bristles on the antennae; thus, our species cannot belong to these genera.

According to the more recent interpretations of *Ripersia* this genus has a compact not cellular anal ring (see Ferris: 1920, l.c. p. 33, Laing: Ann. Mag. Nat. Hist. (10) 4, p. 470, 1929).

The informations concerning *Cryptoripersia* are very scarce. However, the characters given indicate that it is improbable that our new species should belong to this genus.

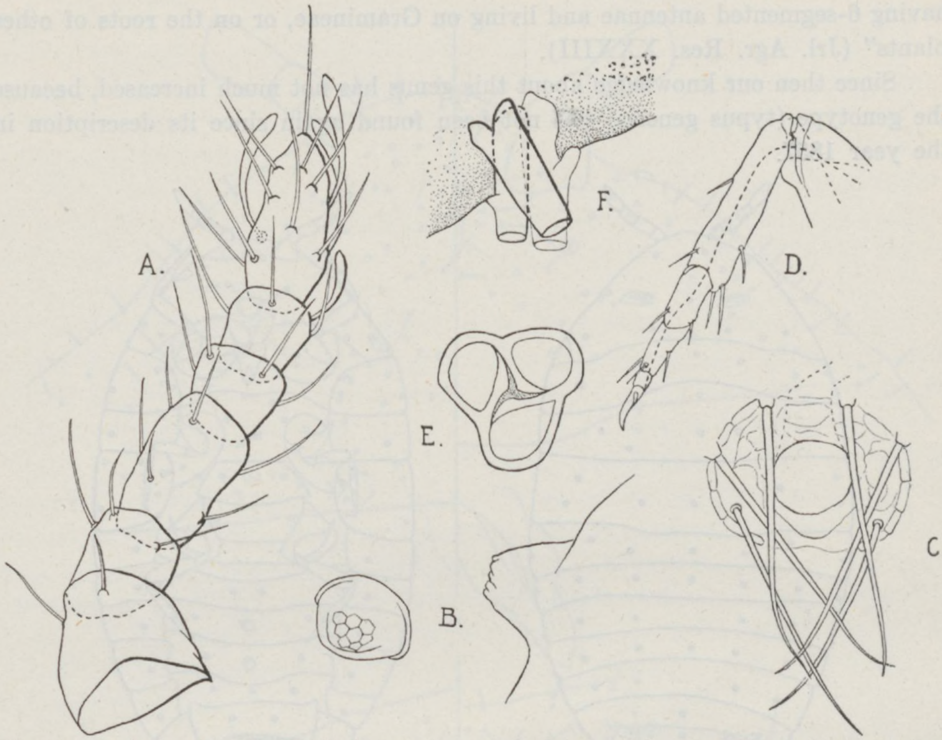


Fig. 3. A. Antenna; B. Ventral protuberances on two of the sternites; C. Anal ring; D. Tibia and tarsus; E. Apical view of one of the tritubular cerores; F. Lateral view of one of these cerores.

The characters of *Ripersiella* and of *Rhizoecus* are in accordance with those of our new species. *Ripersiella,* however, possesses no cerrores with three tubular ducts, whereas *Rhizoecus* possesses these remarkable ducts, but has antennae with 5 segments instead of 6 segments. The number of segments of the antennae has no value as a genus character on account of its variation. Moreover, already many descriptions of species of *Rhizoecus* with 6 segmented antennae are published by LAING and JAMES. So there seems no serious obstacle to include the new species in the genus *Rhizoecus*.

NEDERLANDSCH-INDISCH AMERIKAANSCHE EXPEDITIE NAAR NEDERLANDSCH NIEUW-GUINEA

(3e ARCHBOLD-EXPEDITIE NAAR NIEUW GUINEA 1938-'39)

Lijst van verzamelstations

door

Dr. L. J. TOXOPEUS
(Buitenzorg)

(Met 1 kaart)

1. **Hollandia,** kustplaats aan de Humboldtsbaai, dicht bij de grens van het Mandaat-gebied.

Verzameld in open grasterreinen, in oerbosch en secundair bosch op kalk, en in een rivierbedding op de uitloopers van het Cycloop-gebergte (oude formatie).

Hoogte: 0 - 100 m.

Tijd: 17 Juni - 28 Juli 1938 (droog seizoen), en van 16 - 20 April '39 (einde van den regentijd).

2. **Sentani-meer** en **Cycloop-gebergte.**

Twee excursies ondernomen door J. OLTHOF, assistent-preparateur.

Verzameld in grasterrein, afgewisseld door bosch, aan de N. zijde van het meer, en in oerbosch op verschillende hoogten van het gebergte.

Hoogten: Omgeving van het Sentani-meer 50 m; Cycloopgebergte, Dojo ± 250 m, bivak op 400 m en bivak op 900 m.

Tijd: 23 Juni - 1 Juli 1938 (Sentani-meer en bivaks) en 17 - 20 April 1939 (Dojo).

Verder een collectie *Lepidoptera* aangekocht, verzameld door J. EBELY te Dojo, Oct. en Nov. 1938.

3. **Achterland** van **Hollandia** en **uitloopers** van **Bewani-gebergte.**

Aangekochte collectie, bijeengebracht door W. STÜBER, voornamelijk te Arso.

Hoogte: 200 - 1200 m.

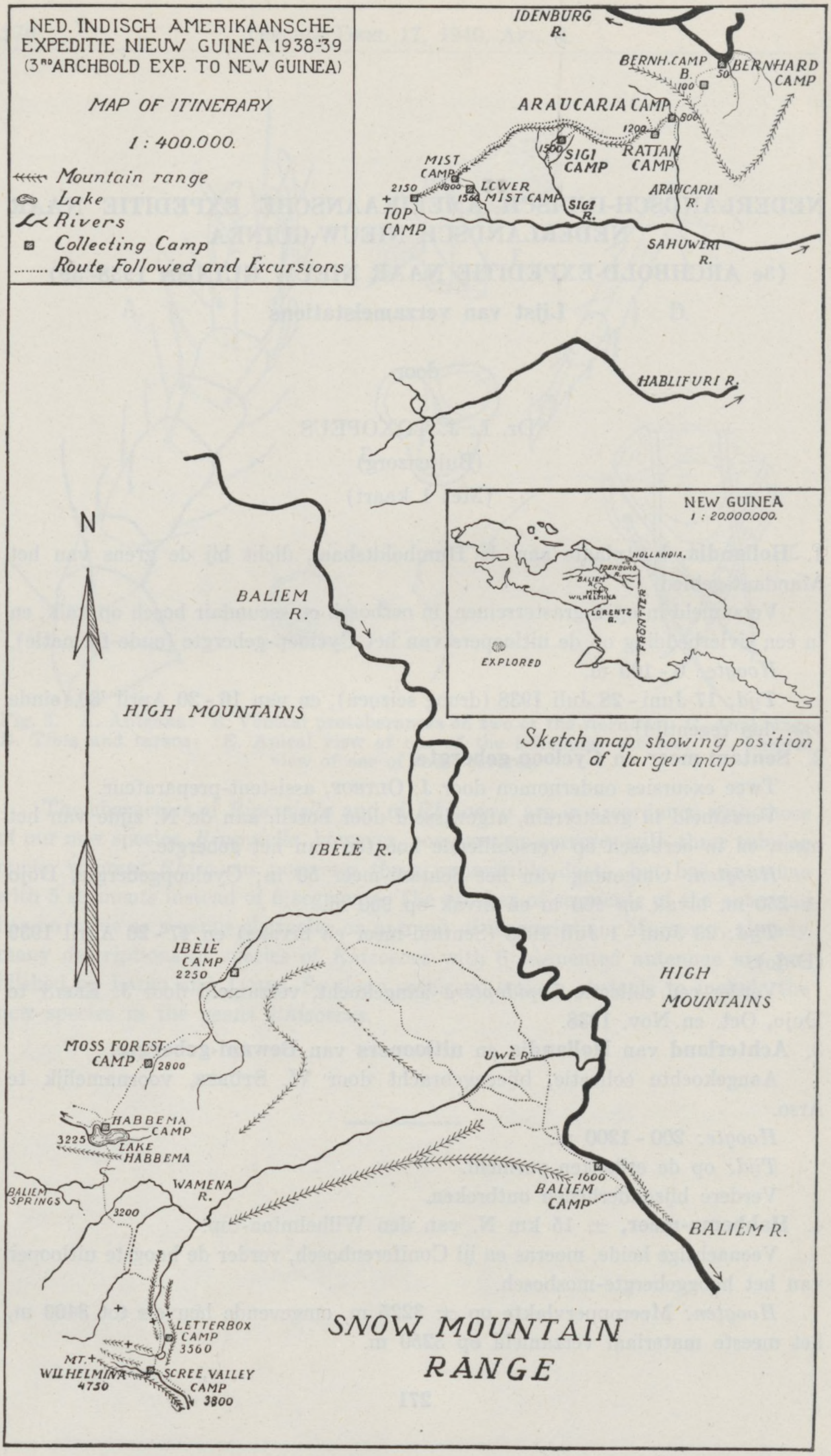
Tijd: op de etiketten vermeld.

Verdere bijzonderheden ontbreken.

4. **Habbema-meer,** ± 15 km N. van den Wilhelmina-top.

Veenachtige heide, moeras en ijl Coniferenbosch, verder de hoogste uitlooper van het hooggebergte-mosbosch.

Hoogten: Meeroppervlakte op ± 3225 m, omgevende heuvels tot 3400 m, het meeste materiaal verzameld op 3250 m.


NED. INDISCH AMERIKAANSCHE EXPEDITIE NIEUW GUINEA 1938-39
(3RD ARCHBOLD EXP. TO NEW GUINEA)
MAP OF ITINERARY
1 : 400.000.
Mountain range
Lake
Rivers
Collecting Camp
Route Followed and Excursions
IDENBURG R.
BERNH. CAMP B.
BERNHARD CAMP
ARAUCARIA CAMP
MIST CAMP
SIGI CAMP
RATTAN CAMP
LOWER MIST CAMP
TOP CAMP
SIGI R.
ARAUCARIA R.
SAHUWIRI R.
HABLIFURI R.
NEW GUINEA
1 : 20.000.000.
HOLLANDIA
IDENBURG
BALIEM
WILHELMINA
LORENTZ R.
FRONTIER
EXPLORED
Sketch map showing position of larger map
N
BALIEM R.
HIGH MOUNTAINS
IBÈLE R.
IBÈLE CAMP 2250
HIGH MOUNTAINS
MOSS FOREST CAMP 2800
UWÈ R.
HABBEMA CAMP
3225
LAKE HABBEMA
BALIEM SPRINGS
WAMENA R.
3200
1600 BALIEM CAMP
BALIEM R.
LETTERBOX CAMP 3560
MT. WILHELMINA 4750
SCREE VALLEY CAMP 3800
SNOW MOUNTAIN RANGE

Tijd: Droge moesson, 29 Juni - 29 Juli 1938 en eenige exemplaren in het begin van den regentijd, meest door de mantri-verzamelaars bijeengebracht in de maand September.

5. **Brievenbuskamp,** ± 4 km O. van den Wilhelmina-top.

Moerassige alpine vegetatie, op de grens van de boomflora.

Hoogte: 3560 m, verzameld tusschen 3500 en 3700 m.

Tijd: 30 Aug. - 13 Sept. 1938, verder door de mantri-verzamelaars gedurende de rest van de maand September.

6. **Puindalkamp,** aan den voet van den Wilhelmina-top.

Alpien, boven de boomgrens, op beschutte plaatsen struikvegetatie.

Hoogte: 3800 m, waar bijna de geheele collectie van dit station werd bijeengebracht. Op een excursie in Z. richting over de pas werd afgedaald tot 3400 m, terwijl op twee tochten tot 4250 m werd geklommen. Op geen dezer drie excursies is veel gevangen.

Tijd: 13 - 29 Sept. 1938; aanvankelijk nog eenige droge, zonnige dagen, later veel mist en regen- of hagelbuien, blijkbaar kenteringweer.

7. **Mosboschkamp,** in het oerwoud op ruim 5 km NO. van het Habbema-meer gelegen.

Hooggebergte-mosbosch, hoofdbestanddeel Sycopsis (?) sp., weinig Coniferen, dichte ondergroei van Orchideae en Varens, 100 m lager een plaatselijke verandering in een rijkere vegetatie zonder dichte mosbegroeiing, tengevolge van beschutte ligging.

Hoogte: 2800 m. Bovendien werd eenig materiaal verzameld op 3000 m, waar een kleine vlakte met veenmoerassen en Coniferen lag, herinnerend aan de omgeving van het Habbema-meer; op 2700 m, in het bovengenoemde rijke regenwoud; en op 2600 m in een diep ravijn, dat door de open gesteldheid veel insectenleven had.

Tijd: Voorexcursie van 22 - 24 Aug. 1938, in den drogen tijd. Eigenlijk verblijf van 8 Oct. - 6 Nov. 1938, begin van den regentijd.

8. **Ibèlèkamp,** aan de grens van het door Papoea's in cultuur gebrachte gebied, op den hoogen oever van de Ibèlè, ongeveer 8 km NO. van het vorige kamp gelegen.

Hoogte: 2250 m. Verzameld werd van 2300 - 2150 m.

Tijd: Voor-excursie op 23 Aug. 1938 in den drogen tijd, verblijf van 6 Nov. - 5 Dec., onderbroken door een patrouilletocht naar de Baliemvallei van 11 - 25 Nov., gedurende welken tijd echter door de mantri-verzamelaars aan de Ibèlè werd doorgewerkt.

De weinige exemplaren, tijdens den patrouilletocht buitgemaakt, staan onder uitvoerig etiket.

De tijd aan de Ibèlè doorgebracht, kenmerkte zich door veel bewolking en wind 's morgens en mist en regen in den avond.

9. **Baliem-rivier,** aan het Z. uiteinde der groote hoogvlakte, temidden van de cultuurgronden der Papoea's, op drie dagreizen van het vorige kamp, en ± 30 km O. van het Habbema-meer. Geen oorspronkelijk oerbosch, veel grasvlakten.

Hoogte: 1600 m.

Tijd: Voor-excursie 15 - 22 Nov. 1938; daarna door den assistent tot 7 Dec. en tenslotte door alle verzamelaars tot 18 Dec. Hoewel regentijd, was het overdag meestal droog, maar bewolkt, terwijl het 's nachts meest regende.

10. **Mistkamp,** op den bergrug ten Z. van het Bernhardkamp aan de Idenburgrivier.

Dicht, zeer vochtig mosbosch in een zadel.

Hoogte: 1800 m.

Tijd: Assistent met mantri-verzamelaars van 25 Dec. 1938 - 6 Jan. 1939, daarna alle verzamelaars tot 19 Januari. Regentijd, met bijna nooit zonneschijn, maar constant mist en regen.

11. **Topkamp,** een vooruitgeschoven post van het Mistkamp, op een weinig begroeid topje gesticht, met minder bewolking.

Hoogte: ruim 2100 m.

Tijd: 20 - 25 Jan. 1939, daarna de mantri-verzamelaars nog tot 10 Februari.

12. **Beneden-Mistkamp,** lager dan de constante mistzône gelegen, in een beschut ravijn, dat op den bovenloop der Sahoeweri-rivier uitkwam.

Hoogte: 1560 m; maar er is verzameld van 1400 - 1700 m.

Tijd: 26 Jan. - 2 Febr. 1939.

13. **Rotankamp** (op sommige etiketten: **Tusschenkamp),** in dicht oerwoud met veel rotanpalmen, op een naar de Araucariarivier afdalende berggraat gelegen.

Hoogte: 1200 m. Door afdaling in ravijnen is tot beneden 1100 m gewerkt.

Tijd: 3 - 14 Febr., onderbroken door een 3-daagschen tocht naar het Bernhardkamp, gedurende welken tijd de assistent echter doorverzamelde; daarna is tot 28 Febr. door de mantri-verzamelaars doorgewerkt, en van 1 - 6 Maart weer door den assistent met 2 Dajaksche verzamelaars.

14. **Sigikamp,** in het moerassige dal van de Sigirivier, met meer open terrein en zonniger dan het Rotankamp.

Hoogte: 1500 m; maar er is verzameld tusschen 1300 en 1600 m.

Tijd: 15 - 28 Febr. 1939.

15. **Araucariakamp,** in de kom van de Araucariarivier, slechts een goed uur gaans beneden het vorige kamp gelegen; regenwoud, veel palmen en riet aan de oevers.

Hoogte: ruim 800 m; verzamelingen van 700 - 900 m.

Tijd: 1 Maart - 4 April 1939. Regentijd, veel stormachtig weer.

16. **Bernhardkamp-Bergvoet,** bij afkorting: **Bernhardkamp-B.** genoemd.

Op de plaats, waar de vlakte van de Idenburgrivier (de Meervlakte) naar het gebergte, dat deze vlakte van de Araucariarivier scheidt, oprijst. Zwaar tropisch regenwoud, aangrenzend aan de vlakte, welke moerassig is.

Hoogte: ± 100 m. Van het Araucariakamp zijn excursies ondernomen naar de berghelling, aan welks voet het kamp lag, waarbij men daalde tot 600 m, later zijn van het bergvoetkamp tochten omhoog tot 450 m gemaakt. De insecten zijn geëtiketteerd met „Boven Bernhardkamp .... m" en datum.

Tijd: Regentijd, echter met matigen regenval. Verzameld werd van 4 - 14 April 1939.

17. **Bernhardkamp,** aan een dooden arm van de Idenburgrivier gebouwd, in den drogen tijd bijna 10 m boven water, in het midden van den regentijd overstroomd. Zwaar oerbosch, plaatselijk moerassig, door vele kreken doorsneden.

Hoogte: ± 50 m: verzameld werd tot den bergvoet.

Tijd: 1. In den drogen tijd door den assistent met Dajaks van 15 Juli - 15 Nov. 1938, de laatste maand echter reeds in de kentering vallend.

2. In den regentijd: 19 - 24 Dec. 1938; 8 - 11 Febr. en 11 - 14 April 1939.

NETHERLANDS INDIAN-AMERICAN EXPEDITION TO NETHERLANDS NEW GUINEA

(3rd ARCHBOLD EXPEDITION TO NEW GUINEA 1938 - '39)

List of Collecting Stations

by

Dr. L. J. TOXOPEUS

(Buitenzorg)

(With 1 map)

1. **Hollandia,** coast of Humboldt Bay, near the frontier of the Mandated Territory. Collections made in open grassy areas, in virgin and in secondary jungle on limestone, and in a river bed on the outskirts of the Cycloop Mts. (old formation).

Altitude: 0 - 100 m.

Time: June 17 - July 28, 1938 (dry season) and April 16 - 20, 1939 (end of rainy season).

2. **Lake Sentani** and **Cycloop Mts.**

Two excursions made, by J. OLTHOF, assistant-collector.

Collections in grassy plains, alternating with forests, at the N. side of the Lake, and in virgin forest at several altitudes of the mountains.

Altitudes: Surroundings of Lake Sentani 50 m; Cycloop Mts. at Dojo ± 250 m, in bivouacs at 400 and 900 m.

Time: June 23 - July 1, 1938 (Lake and mountain camps), and April 17 - 20, 1939 (Dojo). Further a collection of *Lepidoptera* purchased from J. EBELY, Dojo, Oct.-Nov., 1938.

3. **Interior behind Hollandia** and **Outskirts of Mt. Bewani.**

Purchased collections, bought from W. STÜBER, mainly collected at Arso.

Altitude: 200 - 1200 m.

Time: on the labels.

No further data.

4. **Lake Habbema,** ± 15 km N. of Mt. Wilhelmina.

Moorland, fens and sparse coniferous forest, furthermore the highest outposts of the high mountain moss forest.

Altitudes: surface of Lake at ± 3225 m, surrounding hills to 3400 m; most of materials gathered at 3250 m.

Time: dry season, June 29 - July 29, 1938, some specimens in the beginning of the rainy season, chiefly by native collectors (mantri's) during September.

5. **Letterbox Camp,** ± 4 km E. of Mt. Wilhelmina.

Swampy alpine vegetation, at the timber line.

Altitude: 3560 m, collections between 3500 and 3700 m.

Time: Aug. 30 - Sept. 13, 1938, further by native collectors during remainder of September.

6. **Scree Valley Camp,** at the foot of Mt. Wilhelmina.

Alpine above timber line, shrubs at sheltered spots only.

Altitude: 3800 m, where most specimens were collected. On an excursion in S. direction we descended to 3400 m, on two mountain trips upward we reached 4250 m, but results were few.

Time: Sept. 13 - 29, 1938, some dry and sunny days at first, but afterwards mist and rain or hail-showers in profusion, apparently turn of monsoon.

7. **Moss Forest Camp,** in high jungle at good 5 km N.E. from Lake Habbema.

High mountain moss forest, of mainly Sycopsis (?) trees, few Conifers, thick undergrowth of Orchids and Ferns. At a hundred meters lower down local change into richer vegetation without thick moss, due to sheltered position.

Altitude: 2800 m. Some further collecting was done at 3000 m, at a small plateau with bogs and Conifers, recalling the Lake Habbema surroundings; at 2700 m in the rich rainy forest, and at 2600 m in a deep ravine with much insect life owing to its open condition.

Time: Preliminary excursion Aug. 22 - 24, 1938, in the dry season; afterwards a stay from Oct. 8 - Nov. 6, 1938, in the rains.

8. **Ibèlè Camp,** at the borders of Papuan cultivated grounds, situated on the steep banks of Ibèlè R., about 8 km N.E. of the former camp.

Altitude: 2250, collections from 2300 - 2150 m.

Time: Preliminary excursion Aug. 23, 1938, in the dry season, main stay from Nov. 6 - Dec. 5, interrupted by a patrol to Baliem Valley from Nov. 11 - 25, during which the mantri's continued collecting at the Ibèlè R. My few specimens captured during the patrol have got detailed labels. The wheather conditions were bad, cloudy and windy in the mornings and mist and rains in the nights.

9. **Baliem R.,** at the S. extremity of the grand valley, amidst the cultivations of the Papuas, three days' march away from the above-named camp, at ± 30 km E. of Lake Habbema. No primeval forests, many grass-covered hills.

Altitude: 1600 m.

Time: First excursions Nov. 15 - 22, 1938, then collections made by the assistant to Dec. 7, finally by all collectors up to Dec. 18. Although rainy season prevailed, during day time the wheather was fine, but cloudy, while the rains came down at night.

10. **Mist Camp,** on the mountain ridge S. of Bernhard Camp on the Idenburg R. Dense, very damp forest in a saddle.

Altitude: 1800 m.

Time: Dec. 25, 1938 - Jan. 6, 1939 by the assistant and mantris, then till

Jan. 19 by all collectors. Rainy season, nearly no sunshine but constantly fog and rain.

11. **Top Camp,** an outpost of Mist Camp, situated on a sparsely overgrown summit, less cloudy.

Altitude: amply 2100 m.

Time: Jan. 20 - 25, 1939, thereafter the mantris to Febr. 10.

12. **Lower Mist Camp,** below the fog zone in a sheltered ravine, which came out into the head-waters of the Sahuweri R.

Altitude: 1560 m, but collections were made from 1400 - 1700 m.

Time: Jan. 26 - Febr. 2, 1939.

13. **Rattan Camp** (some labels give **'Tusschenkamp')**, in a dense jungle with many rattan-palms, on a ridge sloping into the Araucaria-River.

Altitude: 1200 m. By going down into some ravines specimens were collected to below 1100 m.

Time: Febr. 3 - 14, interrupted by a three days' trip to Bernhard Camp, during which time the assistant carried on collecting, thence till Febr. 28 the mantris continued this work, and from March 1 - 6 the assistant with two Dyak collectors again.

14. **Sigi Camp,** situated in the swampy Sigi River Valley, more open and more exposed to the sun than Rattan Camp.

Altitude: 1500 m, but collecting was done between 1300 and 1600 m.

Time: Febr. 15 - 28, 1939.

15. **Araucaria Camp,** in the basin of the Araucaria R., little more than one hour's walk down from the former camp site. Rain forest, many palms and wild sugar cane on the beach.

Altitude: good 800 m; collections from 700 - 900 m.

Time: March 1 - April 4, 1939. Rainy and often stormy.

16. **Bernhard Camp B,** (base of mountain) situated at the foot of the mountain divide which rises between the Idenburg River Plain, (Meervlakte) and Araucaria River Valley. Dense tropical forest, adjacent to the swampy plain.

Altitude: ± 100 m. Excursions were started from Araucaria Camp down to 600 m, on the slopes at the base of which the camp was built; afterwards ascents from the mountain base reached as high as 450 m. Specimens were labelled: 'above Bernhard Camp .... m' with date.

Time: Rainy season, but with moderate rainfalls. Collections run from April 4 - 14.

17. **Bernhard Camp,** on a dead arm of the Idenburg R., about 10 m above the river bed in dry season, but flooded in the height of the west monsoon. Dense virgin jungle, locally swampy, traversed by many creeks.

Altitude: ± 50 m; collections were made up to the mountain foot.

Time: 1st. in the dry season, by the assistant and Dyak collectors, from July 15 - Nov. 15, 1938, (the last month, however, in the turn of the season).

2nd. in the rainy season; Dec. 19 - 24, 1938, Febr. 8 - 11 and April 11 - 14, 1939.

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REVISIONAL NOTES ON SOME SPECIES OF *COPERA* KIRBY,

With notes on habits and larvae (Odon., Platycneminidae).

By

M. A. LIEFTINCK

(Zoölogisch Museum, Buitenzorg).

Introduction and Acknowledgements.

The present short paper is the outcome of an effort to identify a rich material of *Copera* collected for me in Borneo by Mr. L. COOMANS DE RUITER and Mrs. M. E. WALSH, in the island of Billiton by Mr. F. J. KUIPER, and in Sumatra and Java by L. COOMANS DE RUITER, Dr. M. BARTELS, Dr. L. J. TOXOPEUS and myself.

DE SELYS, who founded the genus *Psilocnemis* (recte *Copera* KIRBY) in 1863, had but 2 specimens of only 1 species of the group discussed in this paper; 2 other species which he had not seen himself were described as new after descriptions he got from H. A. HAGEN; when he revised the genus in 1886, SELYS had about 5 specimens of supposedly 2 species, the others he had not seen; KRÜGER had not examined the earlier described species and therefore described 2 new species of which he possessed 24 specimens (from N.E. Sumatra only). RIS (1915 and 1926) had 13 specimens of the two species described by KRÜGER.

For the present study 235 (181 males, 54 females) have been available from the Buitenzorg Museum's collections and those lent by various other Museums. Very important assistance has been afforded by M. ANTOINE BALL (Brussels Museum) in giving opportunity to study the type of *Psilocnemis vittata* SELYS, by Lt.-Col. F. C. FRASER for giving me specimens of *C. vittata deccanensis* LAIDLAW, by Mrs. HOWARD K. GLOYD (Michigan Museum, Ann Arbor) for the loan of FÖRSTER's specimens of *C. vittata acutimargo*, by Dr. W. LUDWIG (Zool. Institut, Halle a.S.) for the loan of the type of *Psilocnemis imbricata* SELYS, and by Mr. KAI HENRIKSEN (Zool. Museum, Copenhagen) for the loan of the type of *Psilocnemis serapica* SELYS.

Mr. KENZO KUWASIMA (Maloong, P.I.), Messrs. P. BUWALDA (Buitenzorg) and J. C. VAN DER MEER MOHR (Medan), and Frl. Dr. ELLI FRANZ (Naturmuseum Senckenberg, Frankfurt a.M.) have supplied valuable material with their usual generosity. To all these friends I would extend my hearty thanks for their kind help.

Historical summary.

In 1863, in his "Synopsis des Agrionines", DE SELYS established the genus *Psilocnemis* for two groups of species, viz. *marginipes* RAMB. and *ciliata* SELYS. The type-species of the first group was *marginipes* RAMB., the first described

species of the second group being *annulata* SELYS. In group I 5 species were placed that were described successively as *marginipes* (RAMB.) from Java and Malaya, *striatipes* SELYS from Java, *vittata* SELYS from Malaya, *serapica* SELYS from the Nicobars, and *imbricata* SELYS from Padang, W. Sumatra; the latter two were described after notes furnished by HAGEN. Group II, "2me groupe (*Ps. ciliata*)" contained 2 species, the first of these being *annulata* SELYS, from Shanghai, the second *ciliata* SELYS, from Malaya. Group I was separated from group II on the character of the armature of the posterior lobe of the ♀ prothorax.

In 1886, in his "Revision du Synopsis des Agrionines", DE SELYS placed *striatipes* correctly as a synonym of *marginipes*. Unfortunately enough, great confusion was caused by the removal from group I to group II of *serapica*, which he knew only from HAGEN's description. At the same time he added one species, *atomaria* from N.W. Borneo, to the first group as a race of *imbricata*.

The type of the two species, *vittata* and *atomaria*, were in two European Museums, and there is nothing to indicate that direct comparison of the two was ever made. At the present time there is no reason for thinking the two species are not conspecific.

At the end of his description of *Ps. atomaria* DE SELYS remarks: "L'*atomaria*, la *serapica* (si elle en est distincte), la *vittata* et la *marginipes* ont entre elles la plus grande analogie, et pourraient bien n'être au fond que les races locales d'une seule espèce primordiale si l'on admet que la dilatation des tibias et la longueur des appendices anals supérieurs des mâles peuvent varier du plus au moins dans une certaine limite". (p. 123).

The confusion which has arisen in the synonymy of this cluster of species and races is entirely due to the fact that the various 'species' were founded only on m a l e s from various localities scattered all over the archipelago. By the absence of females of *vittata, imbricata* and *serapica,* DE SELYS could do hardly more than pointing out the relationships. On the other hand, everything points to the fact that he did not compare the ♀ prothorax of the common *marginipes* with that of *atomaria,* which was the only species of which he had seen the female.

Group I thus included 4 species: *marginipes* (RAMB.), *vittata* SELYS, *imbricata* SELYS, and *atomaria* SELYS. As we have seen already, one species, viz. *serapica* from the Nicobars, for some inexplicable reason was placed in group II as a race of *annulata,* while *subannulata* SELYS from Tenasserim and Calcutta, and *ciliata* SELYS from Malaya also stood as races of *annulata.*

Of group I, *Copera marginipes* (RAMB.) is well known and will not concern us here. Of group II, LAIDLAW (1917) suggested that the large and well known species *annulata* is one of which long series are necessary for determining the value of the differences which exist between individuals. It is generally accepted by present writers, including I think LAIDLAW himself, that the 'races' *ciliata* and *subannulata* are merely colour-varieties of *annulata,* as is the case with *stevensi* LAIDLAW (1914) from Assam. *C. annulata* is easily distinguished from *marginipes* and the *vittata* group so that it is left out of consideration here.

KIRBY (1890) first designated a genotype (*marginipes* RAMBUR) for *Copera,* the substitute created by him to replace the preoccupied generic name *Psilocnemis* SELYS. KIRBY also catalogued the above-mentioned species.

Owing to the small amount of material which was accessible to previous writers and the consequent uncertainty as to the validity of supposedly specific or subspecific characters, the exact identification of the species of the *vittata* cluster of *Copera* has been a matter of much difficulty. Because of the inadequacy of the earlier descriptions nobody has been able to certainly identify HAGEN's species *serapica,* and it was no easy matter either to decide just what SELYS's *vittata* really was.

In 1898, KRÜGER, while engaged with a study of two closely allied Sumatran species of the *vittata* group, cut the Gordian knot and created two new names for the reception of these species. His introductory remarks are very instructive: "SELYS unterscheidet bei *Psilocnemis* in seiner Revision fünf Arten mit noch vier Rassen, von denen *alatipes* MAC LACHLAN von Madagascar hier nicht in Betracht kommt. Die Art *annulata* SELYS mit ihren Rassen *subannulata* SELYS, *serapica* HAGEN, *ciliata* HAGEN ist durch Grösze (bis 37 mm Abdomen) und ihr Aussehen augenfällig unterschieden von den bleibenden *vittata* SELYS, *imbricata* HAGEN mit Rasse *atomaria* SELYS, *marginipes* RAMBUR; nur *serapica* HAGEN soll ♂ 32, ♀ 29 mm Abdomenlänge haben, somit den kleineren Arten sich nähern. Es sollen die gröszeren Arten sich von den kleineren besonders dadurch unterscheiden, dasz bei ihren ♀ der Hinterrand des Prothorax nicht nach vorn umgebogen ist. In die Gruppe *annulata* hat SELYS in der Revision *serapica* aufgenommen, obwohl er in der Synopsis das Gegentheil in Betreff des Prothorax beschreibt; anderseits spricht er in der Revision die Vermuthung aus, dasz *serapica* von der kleinen *atomaria* nicht verschieden ist. Die kleinen Arten sollen sich im ♀ durch den Prothorax von den groszen unterscheiden, und dabei kennt SELYS weder von *vittata* noch von *imbricata* das ♀, sondern nur von *atomaria* (hier auch nur junge, weisze Thiere) und *marginipes.* SELYS befindet sich somit, wie er auch selber andeutet, in groszer Verlegenheit über diese Arten, dies besonders auch deshalb, weil die ♂ derselben fast gar keine deutlichen Unterscheidungsmerkmale haben, und weil die früher als *striatipes* SELYS beschriebenen ♀ als Art aufgehoben und theils *atomaria,* theils *marginipes* zugetheilt werden muszten. Dazu kommt noch, dasz die jungen Thiere dieser Arten sämmtlich von weiszer Farbe sind und früher als *Platycnemis lacteola* SELYS, *Psilocnemis serapica* var. *pallida* von ihm beschrieben wurden. Es ist daher ohne Vergleichung mit den Typen einfach unmöglich, nach SELYS diese Arten zu bestimmen." (KRÜGER, *l.c.* p. 103 - 104). KRÜGER was therefore fully justified to say that: "Bis ihre eventuelle Identität mit *vittata, imbricata, atomaria, serapica* nachgewiesen wird, [sind] als neue Art[en] zu betrachten: *Psilocnemis acutimargo* n. sp. und *Ps. lobimargo* n. sp." (*l.c.* p. 106).

As these names imply, the characters employed by KRÜGER are mainly based on the structure of the posterior lobe of the ♀ prothorax, and with the

help of his descriptions the discrimination of two closely allied but yet quite distinct species was no longer a matter of much difficulty.

FÖRSTER (*l.c. postea,* 1907, p. 7) followed SELYS and at the same time mistook KRÜGER's *lobimargo* for *marginipes.* But he goes further than SELYS when he says: ......"This type, *Psilocnemis vittata vittata* DE SELYS, includes three well-marked races, namely, *Psilocnemis vittata imbricata* HAGEN (found in Padang in Sumatra, synonymous with *Ps. acutimargo* KRÜGER), also *Ps. vittata serapica* HAGEN, found in the Nicobars, and *Ps. vittata atomaria* DE SELYS, from Borneo." (Translated by F. F. LAIDLAW).

C. atomaria is synonymous with *vittata vittata* and *C. imbricata* is considered a good species, although even now there remains some slight doubt as to the correct determination of *imbricata,* of which I have not seen topotypical females. Further notes on this species are given *postea.*

In 1915, RIS described additional material from the island of Simaloer under the specific name of *acutimargo* employed by KRÜGER, and figured, for the first time, the prothorax of the female. The same writer, in his "Odonaten von Sumatra" (1936) gave a comparison of KRÜGER's two species with the widely spread and common *C. marginipes,* and in a first key to the species, introduced some characters not employed by his predecessors, besides giving excellent figures of the prothorax of the female of *marginipes* and *lobimargo.* We will soon see that some of these characters are ontogenetic and variable, and therefore not necessarily specific characters, as assumed by RIS. Immediately following the tentative key to the species, RIS attempted to homologize the earlier described species of HAGEN-SELYS with KRÜGER's insects but because of the inadequacy of the earlier descriptions his treatise on the synonyms was wrong.

No efforts have since been made to examine the types of *vittata, serapica* and *imbricata,* and although SCHMIDT (1934) discussed 6 males and 5 females from Central South Sumatra, giving useful sketches of the ♂ thorax, this species was wrongly identified as *acutimargo.* Through the kind help of Mr. COOMANS DE RUITER I have been able to examine quite similar specimens from the same region, and these are discussed below under the name *vittata.*

Synonymy of Species and Subspecies.

A careful examination of the various forms and a comparison of the material studied with the existing types has resulted in the following arrangement and synonymy: [1]).

Copera vittata vittata (SELYS), 1863. — Terra typica: Malay Peninsula.
Syn.: *Psilocnemis atomaria* SELYS, 1886.

Copera vittata deccanensis (LAIDLAW), 1923. — Terra typica: Cochin State, S.W. India.

Copera vittata serapica (SELYS), 1863. — Terra typica: Nicobar Is.

Copera vittata acutimargo (KRÜGER), 1898. — Terra typica: N.E. Sumatra.

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[1]) *Copera assamensis* LAIDLAW, which is possibly also a subspecies of *vittata,* has been left out of consideration here.

Copera vittata javana, subsp. n. — Terra typica: S.W. Java.
Copera vittata palawana, subsp. n. — Terra typica: Palawan.
Copera imbricata (SELYS), 1863. — Terra typica: W. Sumatra.
Syn.: *Psilocnemis lobimargo* KRÜGER, 1898.

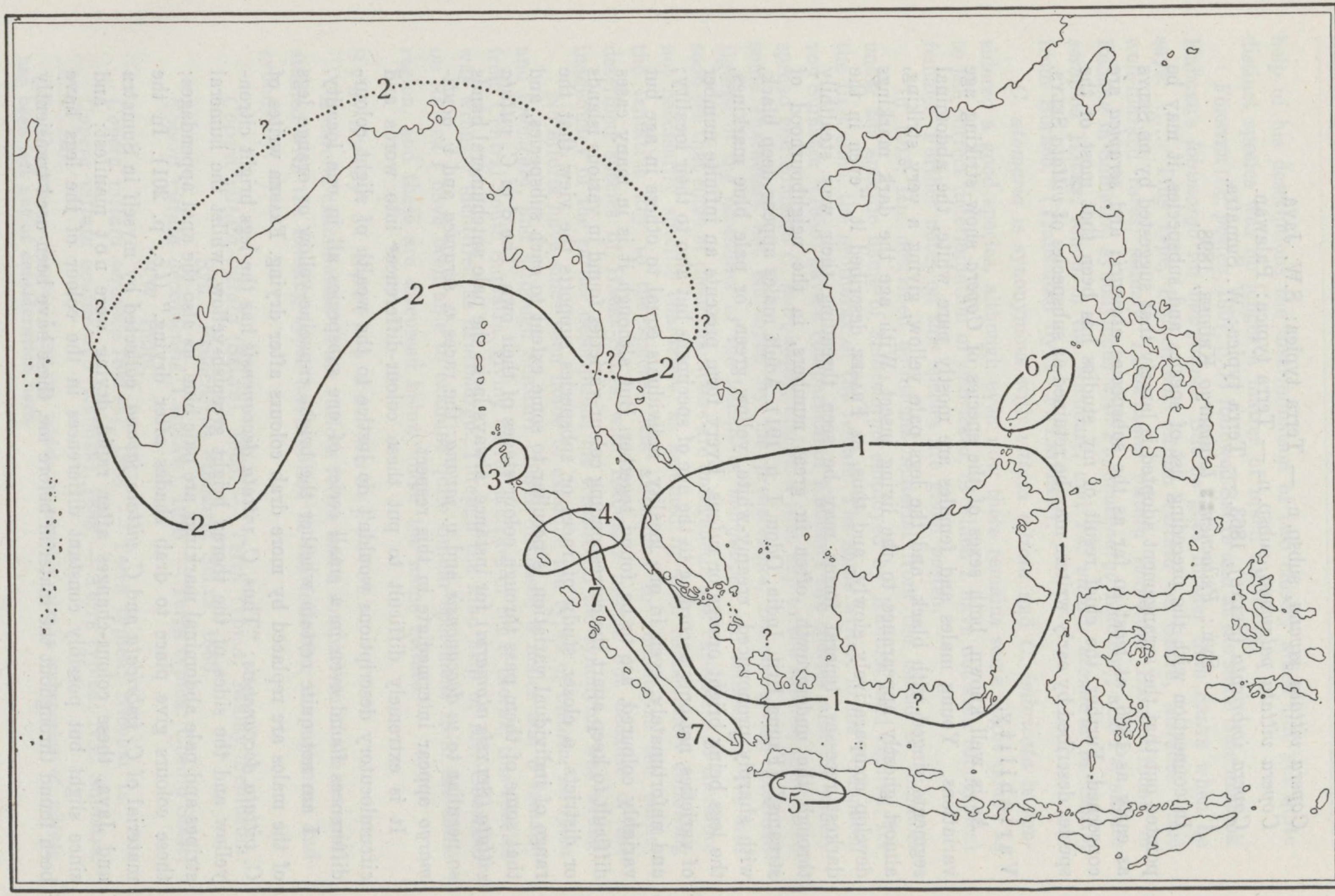
In connection with the preceding list of species and subspecies, it may be pointed out that the arrangement adopted is largely that suggested by DE SELYS as early as 1886, at least so far as the subspecies *atomaria* and *serapica* are concerned. Further, the chief result of my studies has been that most of the species described by early writers may be retained as subspecies of *vittata* SELYS.

Variability.

As is well known, both sexes of the species of *Copera* show striking age variations. Young males and females are mostly pure white, the abdominal segments ringed with black, and the legs pale yellow, giving a very striking, almost ghostly appearance to the living insect. With age the dark markings develop comparatively slowly, and thus, as FRASER described it, "even in the darkest recesses, teneral forms may be seen threading their way stealthily through the undergrowth, often in great numbers, in the neighbourhood of streams." (Fauna Brit. India, Odon. I, p. 191). Adult males appear deep black, with sharply pronounced, creamy-white, yellow green, or pale blue markings, the legs being bright orange or rufous. Every form presents an infinite number of varieties, not only according to the age of specimens but also to their locality; and unfortunately, even in one locality, individuals equal to others in age but variably coloured, are to be found together. But although it is in many cases difficult to keep apart the corresponding colour-varieties found in various islands or districts, a closer study of races or subspecies supports the view that the range of individual variation is peculiar to some extent to each subspecies, and that some of them pass through colour-stages of their own. The ♂ of *C. vittata vittata* (SELYS's *atomaria*) for instance, always lacks the pale antehumeral bands so peculiar to *v. deccanensis* and *v. javana;* the races *v. serapica* and *v. acutimargo* appear intermediate in this respect.

It is extremely difficult to put these colour-differences into words and circumlocutory descriptions wouldn't do justice to the wealth of slight colour-differences found even in a small series of one subspecies all in one locality.

I am not quite certain whether the bright capucine-yellow or orange legs of the males are replaced by more drab colours after drying. FRASER writes of *C. vittata deccanensis:* "Thus, *C. vittata deccanensis* has the legs bright citron-yellow and the sides of the thorax bright greenish-yellow, whilst the humeral stripes and pale abdominal markings are pale blue, as also the anal appendages; these colours give place to drab shades after drying." (*l.c.*, p. 201). In the material of *C. imbricata* and *C. vittata javana,* collected by myself in Sumatra and Java, these colour-changes after rapid drying were not manifest; and since slight but possibly constant differences in the colour of the legs have been found throughout the material before me, these have been used transiently



Map showing distribution of *Copera vittata* (SELYS) and its subspecies, and of *C. imbricata* (SELYS).
1. *C. vittata vittata* (SELYS). — 2. *C. vittata deccanensis* (LAIDLAW). — 3. *C. vittata serapica* (SELYS). — 4. *C. vittata acutimargo* (KRÜGER). — 5. *C. vittata javana*, subspec. nov. — 6. *C. vittata palawana*, subsp. nov. — 7. *C. imbricata* (SELYS).

in the key to the subspecies of *vittata*. However, in view of the great ontogenetic variation in colours, these differences should be relied upon with caution.

Structural Characters.

The males of *Copera* present marked individual variation. It has been found that the extent of the pale colour of the last segments of the abdomen, a character employed by KRÜGER and RIS, is of no value in discriminating species or subspecies. It has further been ascertained that the ratios between the length of hinder wing and abdomen, in individuals of one species or subspecies from one locality, vary considerably and hence cannot be used as a means of distinction.

The most valuable specific and subspecific characters are found in the degree of dilatation of the hind tibiae, and in the anal appendages of the male. These differences are enumerated in the key and figured on the accompanying plates.

A character which is constant for *C. imbricata* and all the races of *C. vittata* but one which I have not seen noted, is that the superior anal appendage carries on its ventral surface a very distinct tooth- or rather more hook-like projection. This hook originates from the middle of the appendage, at its extreme base, and is best visible when looked at from behind. Sometimes the spur is well visible in side-view but ordinarily it is concealed and not visible without a partial removal of the inferior appendage. In *C. imbricata* this inconspicuous projection is narrow basally and very slenderly hooked, whereas in all the races of *vittata* it is broadly triangular at base, much more flattened dorso-ventrally, with the apex narrow and curved downwards or upwards, according to its position. This slight but noteworthy difference in the shape of the basal spur in the males of *C. vittata* and *C. imbricata*, may indicate some interesting sexual co-adaptation. As the prothorax and anterior border of the mesonotum are armed quite differently in the females of these two species, it would be interesting to correlate definitely the structures of the two sexes of each species when in the copulatory position.

The males, although better known, are much less easily characterized than the females, which have as very useful distinguishing characters the remarkable structure of the posterior margin of the prothorax and the shape and extent of the median process of the anterior border of the mesonotum. By the employment of these characters it is possible to subdivide the species *vittata* into a number of clearly defined subspecies. In the latter case it must be noticed that in those races in which lateral developments of the hind margin of the prothorax occur, these developments are relatively weakly chitinized and some variation or post-mortem distortion must be looked for.

Geographical Distribution.

According to present information the genus *Copera* extends from India through Indo-China and China to Japan and Formosa, and south-eastwards through the Malay Peninsula as fas as the Lesser Soenda Islands, Flores and Soemba. Two species are found in the Ethiopian Region.

The distribution of the two Asiatic species discussed in this paper is still very incompletely known and much, still, remains to be learned concerning the limits and areas of distribution of *C. imbricata,* and perhaps even more of the races *deccanensis* and *acutimargo* of *C. vittata.*

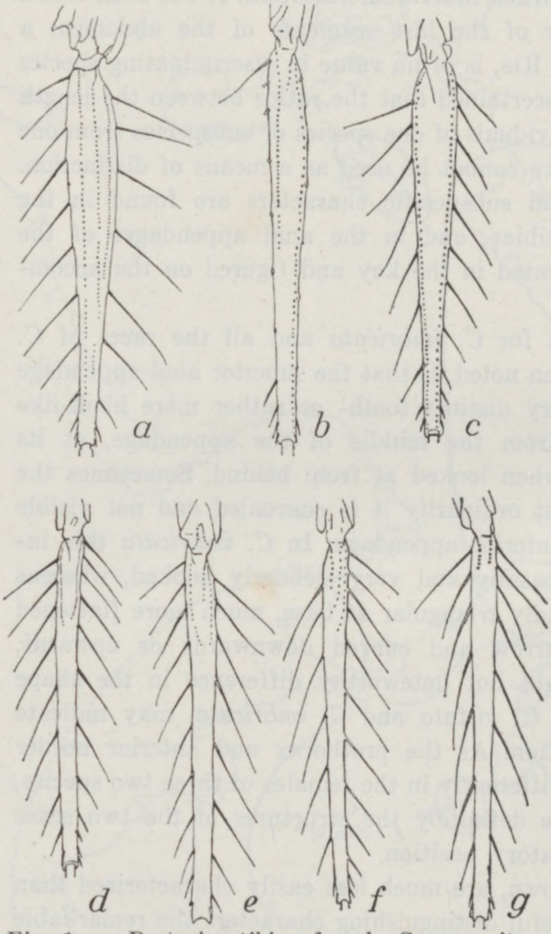


Fig. 1. — Posterior tibia of male *Copera vittata serapica* (a); *C. v. deccanensis* (b); *C. v. javana* (c); *C. v. vittata* (Billiton, d); *C. v. palawana* (e); *C. imbricata* (lectoholotype, W. Sumatra, f); *C. imbricata* (S. Sumatra, g).

The restricted distribution of *imbricata* and each subspecies of *C. vittata* is the more remarkable when contrasted with that of the allied species *C. marginipes,* with which they are nearly always associated in India, the Malay Peninsula, Sumatra and Java. This common species is distributed all over the continent of southeast Asia; but although it ranges to the islands of Flores and Soemba in south-easterly direction, it has not, so far as I am aware, been reported from Borneo, the Philippines or Celebes.

As far as our present knowledge goes, *C. imbricata* is confined to the islands of Sumatra, from 'Soekaranda' on the northern slope of the van Heutsz Mts. (Wampoe River plain) southwards to the Ophir district, and thence west of the Barisan Range to Padang, Benkoelen and the southern Lampoeng districts, where it is very common. A northern and a southern subspecies of *imbricata* may ultimately prove definable.

The races of *C. vittata* are best defined. Of the Indian *deccanensis* the exact limits of variation and of its distribution are unknown. It is most nearly related to *acutimargo,* from N.E. Sumatra and Simaloer, and these races possibly intergrade in Burma and Lower Siam, from where I have not seen specimens [1]). This race is also reported from the Mergui Archipelago but the record needs confirmation.

[1]) *Copera vittata assamensis* LAIDLAW, which I have not examined, is considered a distinct species by FRASER (cf. LAIDLAW, *loc. cit. postea,* 1914, and FRASER, *l.c.* p. 201 - 203). According to FRASER, it ranges from Assam to Indo-China and fills up the gap on our map showing the distribution of subspecies.

C. vittata serapica is a well-marked race, probably confined to the Nicobar Islands. The typical subspecies *vittata* inhabits the southern Malay States (northern limits unknown), and the whole of the great plains of S.E. Sumatra; it is common all over the island of Billiton and apparently universally distributed in the lowlands of Borneo. *C. vittata vittata* varies considerably in colour throughout its range, but the structural characters are remarkably constant. I have neither seen examples from the islands of Banka, nor yet from the lowlands of South Borneo, but it will doubtless turn up there sooner or later.

A very distinct subspecies occurs in the wooded districts of South Java; this race, *javana* subsp. n., appears to be closely related to the Indian *deccanensis*.

Lastly, the most eastern subspecies, *palawana* subsp. n., is found in the island of Palawan. It shows remote affinities with typical *vittata* and structurally comes very near to it, but its colours are very different, and it is remarkable on account of its extreme melanism.

Key to the Species and Subspecies [1]).

The following table shows the grouping of *imbricata* and the subspecies of *vittata*, which I suggest, and indicates the characters, chiefly structural it is true, on which I rely to establish them. Except where some specific condition demands mention of them, the details of the coloration of the body are given under each subspecies or are expressed in the colour-pattern diagrams on pls. 10 - 12, and are not repeated in the key.

1. ♂. Sup. anal apps. divergent, usually less than half as long as the inferior pair, their inner margin at first parallel in dorsal view, thence distinctly and rather abruptly divaricate with slightly outbent tips; in side-view rather swollen before the middle, with the apices slender and depressed. Inferior ventro-basal tooth very slender and hook-like from base to apex, the tips finely curled (pl. 13 fig. 8a). Inf. apps. in dorsal view broad at base, basal third at most with a blunt, obtuse-angulate or slightly irregular projection along inner margin, thence tapering very gradually towards the apex which is broadly rounded; in side-view broad at base and almost straight, thence slightly and evenly downbent, tapering very gradually to a rounded, obtuse apex (pl. 13 fig. 3 and 8). Humeral pale lines complete though narrow. Thoracic sides variably mottled with brown; upper half of mesepimera for the greater part pale-coloured (pl. 10, fig. 6 - 8). Legs orange-buff to capucine-orange. Apices of all femora finely bordered with black. Posterior two pairs of tibiae not noticeably dilated (fig. 1 f-g). —

[1]) *Copera vittata assamensis* is omitted from this key.

♀. Posterior lobe of prothorax short and broad, depressed and of simple structure, its hind border with a shallow median concavity lacking any protuberances; the lobe in side-view is directed straight backwards and appears roughly triangular in outline. Antero-median mesonotal projection extremely short, its anterior border almost in a straight line with the laminae mesostigmales (pl. 14 fig. 8). Length: ♂ abd. + app. 28 - 33.2, hw. 16 - 18.5; ♀ 27 - 30, 17.8 - 20 mm. Hab.: Sumatra. .... ***imbricata.***

1'. ♂. Sup. anal apps. directed almost straight backwards, at least half as long as the inferior pair; in side-view slightly swollen and nodded before the apex. Inferior ventro-basal tooth broadly triangular, tapering gradually toward apex, which is acutely pointed (pl. 13 fig. 2a and 5a). Inf. apps. in dorsal view of slenderer build, more abruptly narrowed about their middle and provided along inner margin with obtuse or rectangulate protuberances; apices more or less pointed. Body-colouring and structure of legs variable. — ♀. Posterior lobe of prothorax of complex structure: usually deeply notched and with the angles of the lobe prolonged upwards and strongly forwards so as to form two divergent lobes of variable length and shape. Antero-median mesonotal projections sub-quadrangular, projecting anterad and beyond the anterior margin of the laminae mesostigmales (pl. 14 fig. 1 - 7). Size variable. Hab.: India to Borneo and Palawan. (*vittata*) 2

2. ♂. Legs black; posterior two pairs of tibiae not noticeably dilated (fig. 1e). Head above and thorax coloured blue and black (pl. 10 fig. 20 - 21). — ♀. Head and thorax deep black marked with palest bluish-white (pl. 10 fig. 22). Posterior lobe of prothorax shaped much as in *vittata vittata* (pl. 14 fig. 7). Length: ♂ abd. + app. 29.5 - 29.8, hw. 16.5 - 17; ♀ 28.5, 18 mm. Hab.: Palawan. .... ***vittata palawana.***

2'. ♂. Legs pale-coloured. ♂♀. Head and thorax with no definite blue colouring. 3

3. ♂. Posterior two pairs of tibiae not noticeably dilated. — ♀. Lateral prolongations of posterior lobe of prothorax either rather short and horn-like, or very long, narrowly triangular and rather pointed apically. 4

3'. ♂. Posterior two pairs of tibiae distinctly dilated. — ♀. Lateral prolongations of posterior lobe of prothorax more or less rounded apically and usually in the form of broad lamellae. 5

4. ♂. Dorsum of synthorax with pale humeral stripes complete and sharply defined, a little narrower than in *deccanensis* (pl. 10 fig. 1 - 2); side predominantly pale-coloured, variably and similarly mottled with brown to *deccanensis* but dark markings on metapleurae ill-defined and paler. Legs carnelian-red. Anal apps. intermediate between *deccanensis* and *vittata:* superiors distinctly longer than half the inferior pair, slender and evenly narrowed posteriorly, without mesial sub-basal angular projection in dorsal view; inferiors similar in principle to *deccanensis* though still slenderer, the inner shelf-like projection less broad and the protuberances more obtuse;

apices rounded as in *deccanensis.* — ♀. Posterior lobe of prothorax very deeply notched and with the angles prolonged and strongly recurved so as to form two long, divaricate, narrowly triangular, pointed lobes that ly on the back of the prothorax. Antero-median mesonotal projection saddle-shaped, much swollen basally (pl. 14 fig. 3). Length: ♂ abd. + app. 31 - 32.2, hw. 16 - 17.5; ♀ 28.5 - 29.5, 18 - 19 mm. Hab.: N. Sumatra.

vittata acutimargo.

4′. ♂. Dorsum of synthorax with pale humeral stripes incomplete or absent altogether, usually consisting of a row of separate spots or points; sides predominantly brown or blackish-brown, especially on mesepimera; metapleurae variably mottled with yellow. Legs capucine- to mikado-orange. Anal apps. shorter and less slenderly built, superiors about half as long as inferior pair, with a distinct mesial, sub-basal, angular projection in dorsal view; inferiors with two low mesial protuberances along margin of basal third; apices bluntly pointed (pl. 13 fig. 5 - 6). — ♀. Posterior lobe of prothorax short and broad, recurved; median incision very broad and ⊔ -shaped, with the angles produced into short and small, divaricate, flattened hooks, which project upwards and a little forwards or sidewards (pl. 14 fig. 5 - 6). Subspecies usually of small size: ♂ abd. + app. 26 - 32, hw. 14 - 17.5; ♀ 24 - 28.5, 15.5 - 17.5 mm. Hab.: Malaya, Sumatra, Billiton, Borneo. .... ***vittata vittata.***

5. ♂. Humeral pale stripes incomplete. Posterior two pairs of tibiae strongly dilated (fig. 1a). Legs long, rufous, femora not obscured apically. Metapleurae of thorax apparently unmarked (pl. 10 fig. 4). Inner margin of inf. anal apps. with the ante-median protuberances obtuse, only little projecting in dorsal view (pl. 13 fig. 2). — ♀. Posterior lobe of prothorax with the median division narrow in dorsal view, the angles prolonged upwards as rather narrow lobes (pl. 14 fig. 2). Length: ♂ abd. + app. 32.3, hw. 18; ♀ 29.2, 19.5 mm. Hab.: Nicobar Is. .... ***vittata serapica.***

5′. ♂. Humeral pale stripes complete and rather broad (pl. 10 fig. 1, 2, 23). Posterior two pairs of tibiae less strongly dilated (fig. 1b, c). Legs shorter, differently coloured. Metapleurae striped with brown or blackish. Inner margin of inf. anal. apps. with the antemedian protuberances sharply pronounced, obtuse- or almost rectangulate in dorsal view. — ♀. Posterior lobe of prothorax with the median division broader in dorsal view, the angles broadly lamellar and only slightly upcurved. 6

6. ♂. Posterior two pairs of tibiae only slightly dilated (fig. 1b). Legs carnelian red. Sup. anal. apps. in side-view rather inflated on middle, apices twisted and broadly rounded (pl. 13 fig. 1). — ♀. Posterior lobe of prothorax very broad, shallowly notched, angles widely divaricate, projecting forwards and slightly upwards as broad, ear-like lobes (pl. 14 fig. 1). Hab.: India.

vittata deccanensis.

6′. ♂. Posterior two pairs of tibiae markedly dilated (fig. 1c). Legs mikado-

orange. Sup. anal apps. in side-view thumb-shaped, apices not twisted (pl. 13 fig. 4). — ♀. Posterior lobe of prothorax narrower, deeply notched, angles slightly divaricate, projecting almost straight forwards as oval blades (pl. 14 fig. 4). Hab.: Java. .... ***vittata javana.***

Copera vittata deccanensis LAIDLAW.

1923. LAIDLAW, Rec. Ind. Mus. 13, p. 337 - 339. — ♂♀ Cochin State, S. W. India.
1923. FRASER, J. Bomb. Nat. Hist. Soc. 29, p. 744.
1924. FRASER, Rec. Ind. Mus. 26, p. 428, 498 (distrib., biol. notes). — S.W. India.
1931. FRASER, Ibid. 33, p. 448 (distrib.). — India.
1933. FRASER, F. B. I. Odon. I, p. 192 (key), 198-201, fig. 88a-b (heads ♂ Bengal-Burma & S. India), 89 (apps. ♂ S. India). — ♂♀ "India, Bengal, Assam, Burma, Siam" (*vittata*).
1933. FRASER, J. Bomb. Nat. Hist. Soc. 36, p. 608 (key), 612-614, fig. 2c (head ♂). — "India, Assam, Burma, Siam" (*vittata*).

Material studied: — 9 ♂, 2 ♀ (juv.-ad.), from S. Peninsular India. — 4 ♂, 1 ♀, Nilgiris, 3000 - 3500′, Wynaad, 19.XI.1922, Nadgani, 24.VIII.1922, Devalashok, 16.X.1921; 1 ♂, Gudalur, 4000′; 2 ♂, 1 ♀, Coorg, Makut, 29.XI.1923, and Srimangala, 20.I.1924; all Lt.-Col. F. C. FRASER leg.; 2 ♂, Palni Hills, 3500 - 4000′, 28.VIII.1923, Major FRERE leg. All in the author's collection.

Resembling pale specimens of *C. vittata javana* but legs differently coloured, tibiae of posterior two pairs less markedly dilated, and apical segments of abdomen more extensively pale-coloured.

M a l e (ad.). — Head, prothorax and thorax rather similar to *javana* (pl. 10 fig. 1 - 2). Humeral pale bands complete and very wide, especially ventrally, where they are only little narrower than the episterna. A yellow line bordering the median carina. Thoracic sides variably marked with brown; metepisternal and metepimeral stripes confluent, as is the dark stripe covering the second lateral suture. Venter pale-coloured.

Legs unicolorous carnelian-red, femora not obscured apically. Posterior two pairs of tibiae only slightly dilated (much less so than in *v. javana* and *v. serapica*).

Abdomen comparatively very long, coloured similarly to the other subspecies. The pale basal rings of the segments 3 - 7 whether or not interrupted mid-dorsally, greenish- or bluish-white in well-preserved examples. Segm. 9 bears a large cream-coloured spot covering most of the dorsum. In 3 males (adulti from Makut, Coorg, and the Palni Hills), this spot extends from end to end, occupying the entire dorsum; on the apical half it covers also part of the sides, while it is slightly narrowed and restricted to the dorsum on the basal half of the segment. In the remaining specimens only the apical half to two-thirds of the segment are marked with white, the pale spot being three-pronged or three-lobed anteriorly. Segm. 10 entirely cream-coloured.

Anal appendages shaped as on pl. 13 fig. 1; yellowish-white, inferior pair with some basal, interior, dark streaks, a stripe on their ventral surfaces, and with the apices blackish.

Female (ad.). — The two specimens in our collection agree in most respects with FRASER's descriptions of this sex. This author's notes on the shape of the posterior lobe of the prothorax, however, are incorrect ("posterior lobe deeply notched, with a small median lobe lying within it, angles of lobe prolonged as fine spines, strongly divergent forwards", *loc. cit.* 1933, p. 200). In the two females examined by me, the lobe is neither deeply notched, nor are the angles of the lobe prolonged as fine spines; in fact, the posterior lobe is only shallowly notched, while the angles are prolonged as very broad ear-like lobes, which are directed forwards and a little sidewards (pl. 14 fig. 1, Nadgani, Nilgiris).

The ventral surface of the thorax is either entirely unspotted, or bears three blackish streaks, two elongate lateral ones, and one, rather more roundish, spot on the middle of the poststernum (intersternum of GARMAN, 1917). Lastly, it may be well noted that the blackish marks on the terminal abdominal segments vary a great deal in size and shape.

Length: ♂ abd. + app. 32.5 - 35.2, hw. 17.8 - 19.2; ♀ 29.5 - 32, 19 - 20 mm. (FRASER, *loc. cit.*: ♂ 28 - 34, 16 - 18; ♀ 28 - 30, 18 mm, Indian specimens only?).

Copera vittata assamensis LAIDLAW.

1914. LAIDLAW, Rec. Ind. Mus. 8, p. 342 - 343. — ♂ (♀?) Upper Assam.
1917. LAIDLAW, Rec. Ind. Mus. 13, p. 338 (diagnosis).
1933. FRASER, F. B. I. Odon. I, p. 608 (key), 614 - 615. — ♂ Assam; "Assam to Indo-China" (*C. assamensis*).

I have not seen this species, nor have I had opportunity to satisfy myself as to the correctness of the specific determination by FRASER, but, as Dr. LAIDLAW informs me, it appears distinct from *C. vittata deccanensis* LAIDLAW, and *vittata vittata* SELYS. According to LAIDLAW and FRASER, the position of the ♀ of *assamensis* is uncertain.

The following (incomplete) notes are taken from the original description:

♂. Legs rich russet-brown with black spines, the posterior pair of tibiae show a trace of dilatation.

Anal appendages dull brown, upper pair one half the length of lower pair. Both pairs straight, tapering, cylindrical.

♀. The prothorax has a pair of short forwardly directed spurs projecting from the middle of its dorsal posterior margin.

Length of abdomen ♂ 32, hind wing 17; ♀ 30, 17 mm. — 1 ♂, 1 ♀ N. Lakhimpur, base of hills, Upper Assam (H. STEVENS). The type is in the Indian Museum, Calcutta.

Copera vittata serapica SELYS.

1863. SELYS, Bull. Acad. Belg. (2) 16, p. 171. — ♂♀ Nicobars (*Psilocnemis serapica*).
1886. SELYS, Mém. cour. Acad. Belg. 38 (4), p. 121 (key), 125. — ♂♀ Nicobars (*Psilocnemis annulata* race *serapica*).
1907. FÖRSTER in LAIDLAW, Fasc. Malay. Zool. 4, p. 7 (note) (*serapica*).

Material studied: — 1 ♂ (ad.), 1 ♀ (nearly ad.), labelled: "Nikobar maj(or)", "*Psil(ocnemis) serapica* Hagen ♂, ♀" (in HAGEN's hand), ♂ with additional label: "Hagen det.", in the Copenhagen Museum. These examples are selected here as l e c t o h o l o t y p e ♂ and a l l o t y p e ♀. (In the Copenhagen Museum are five more male paratypes of *serapica*, all topotypical and identified by HAGEN; these I have not examined).

The two specimens, male and female, now before me, need no full description. SELYS's notes on the colours of the male, copied from HAGEN's, apply perfectly to the one examined by me and are sufficiently detailed to justify its separation from *vittata* as a subspecies. ("Se distingue bien de la *vittata* par sa taille plus forte et les pieds du mâle dilatés", *l.c.* p. 171). Unlike *vittata deccanensis* the humeral pale thoracic band tends to become obliterated, as in typical *vittata*, but the sides of the thorax lack the dark stripes and spots so characteristic for that race, approaching typical *imbricata* from W. Sumatra very closely.

Thorax unicolorous ventrally, without black streaks.

The legs are rather long, uniformly rufous, without any indication of an apical obscuration of the femora. The femora, when adpressed to the body, reach the base of the second abdominal segment. Posterior two pairs of tibiae strongly dilated (fig. 1a).

Abdomen (pl. 11 fig. 1) with the posterior membrane of segm. 9 and most of segm. 10 maize-yellow, 10 with a black ring occupying about the basal one-sixth of the segment.

Superior anal appendages maize-yellow, ventro-basal tooth black. Inferior pair lemon-yellow, basal half of mesial tubercle black (pl. 13 fig. 2).

The f e m a l e, although apparently quite matured, has the ground-colour of the body cartridge-buff. The dark marks on the anterior portion of the head are not sharply defined, brownish-black in colour, with a rusty tinge in front of frons. Prothorax entirely yellow, shaped as on pl. 14 fig. 2.

Dorsum of synthorax bronzed black on each side of the median carina, mesepimera marked with brown as shown on pl. 10 fig. 5. Venter pale.

Legs cream-buff to pale orange-yellow; apical margin of all femora and tibiae very narrowly and but slightly obscured.

Wings long, pterostigma pale brown surrounded by a whitish margin.

Abdomen cream-buff, segments diffusely ringed with brown apically, as shown on pl. 12 fig. 1; apical segments buff-yellow.

Length: ♂ abd. + app. 32.3, hw. 18; ♀ 29.2, 19.5 mm.

Copera vittata vittata SELYS.

1863. SELYS, Bull. Acad. Belg. (2) 16, p. 170. — ♂ Malacca (*Psilocnemis vittata*).
1886. SELYS, Mém. cour. Acad. Belg. 38 (4), p. 121 - 122. — ♂ Malacca (*Psilocnemis vittata*).
1886. SELYS, Ibid., p. 121 (key), 122 - 123. — ♂♀ Labuan, Borneo (*Psilocnemis atomaria*).
1902. LAIDLAW, P. Z. S. London, p. 386. — ♂♀ Kwala Aring, notes (*atomaria*).
1907. FÖRSTER in LAIDLAW, Fasc. Malay. Zool. 4, p. 7 (remarks on synonymy) (*vittata* with 'races' *imbricata, serapica* and *atomaria*).
? 1914. LAIDLAW, Rec. Ind. Mus. 8, p. 342 - 343. — ♂♀ Upper Assam (*vittata assamensis*).
1917. LAIDLAW, Rec. Ind. Mus. 13, p. 338 (descr. ♂ Borneo) (*vittata atomaria*).
1920. LAIDLAW, P. Z. S. London, p. 334, fig. 3 (proth. ♀). — ♂♀ Sarawak (*atomaria*).
1931. LAIDLAW, J. Fed. Mal. States Mus. 16, p. 247. — Borneo, cat. (*atomaria*).
1934. SCHMIDT, Arch. Hydrob. Suppl. 13, p. 336, fig. 30b-c (thor. ♂). — ♂♀ Centr. S. Sumatra (*acutimargo*).
1935. LIEFTINCK, Misc. Zool. Sum. 92 - 93, p. 8 (pars!). — Sumatra (*acutimargo*).
1936. KIMMINS, J. Fed. Mal. States Mus. 18, p. 88. — ♂♀ Sarawak (*atomaria*).

Material studied: — 82 ♂, 33 ♀ from Malaya, S.E. Sumatra, Billiton, and Borneo (various districts). — 1 ♂ (ad.), labelled: "MAL/CA" (round), "Mal. W(allace)" (square, yellow, SELYS' hand), "*Psilocnemis vittata* D.S. ♂ Malacca" (brown, SELYS' hand), "*Ps. vittata* ♂" (yellow, SELYS' hand), holotype in the Brussels Museum. 2 ♂, 1 ♀ def. (juv.), Perak, Prof. RUD. MARTIN (RIS' hand), in the Senckenberg Museum (unnamed). Billiton I., 23 ♂, 11 ♀ (juv.-ad.): Tandjong Pandan, Ajer Nangka & Tjeroetjoek, 2.VIII, 5.IX, 12.X, 3.XI, 24.XII. 1935 & 21.I, 16.II, 31.III - 10.IV, VI & IX.1936, all F. J. KUIPER leg. S.E. Sumatra: 3 ♂, 3 ♀ (juv.-ad.), Palembang Res., Palembang & Soengei Doca Rd., sea-level, 25.IX, 16-25.XI & 21.XII.1937, L. COOMANS DE RUITER leg. 1 ♂, 1 ♀ (ad.), Riouw Res., Rengat-Inderagiri, Pangkalankasai, 2.IV.1939, P. BUWALDA leg. Borneo: 7 ♂, 4 ♀ (juv.-ad.), W. Borneo, Singkawang distr., Tjapkala, Bakoean, Patengahan etc., 7-9.XII.1931, 18.II & 4.IV.1932, L. COOMANS DE RUITER leg. 42 ♂, 12 ♀ (juv.-ad.), E. Borneo, Koetai, Sangkoelirang, Pelawan Besar, Kariorang etc., III, V-VI.1937, M. E. WALSH & J. W. QUARLES DE QUARLES leg. 1 ♀ (juv.), Centr. E. Borneo Expedition 1925, H. C. SIEBERS leg. 1 ♂ (juv.), Sarawak, Kuching, ROLLE vdt., 9.I.1896, ex coll. F. RIS, in the Senckenberg Museum. 2 ♂ (ad.), Banguey (off N. Borneo), W. KEDENBURG, ded. 20.VII.1894, in the Hamburg Museum.

Of the typical *Copera vittata,* I have been able to examine, and to study carefully, the type from "Malacca" (Singapore?) in the Brussels Museum collection, and a very large series of both sexes chiefly from various districts of Borneo, the island of Billiton, and from the lowlands of E. and S.E. Sumatra. These individuals tally very well with the type so that I have no doubt but that all these specimens are correctly referred to the present subspecies.

Apart from structural details, *C. vittata vittata* is chiefly characterized by its small size and dark body-colouring. The pale humeral stripes on the

dorsum of the synthorax are never complete, either indicated by irregular yellow lines and spots, or wanting altogether. The sides of the thorax are preponderantly blackish or brown, variegated with yellow.

The colour of the legs varies from capucine-orange to mikado-orange in all specimens from the Malay Peninsula, Billiton, Sumatra, and West Borneo; all of them agree in that the apices of the femora are finely bordered with black. In our series of males from East Borneo, however, the legs appear rufous, and there is no fine black line bordering the apical margin of the femora. Posterior two pairs of tibiae not noticeably dilated (fig. 1d).

Male (including type). — Head, thorax and abdomen, see pl. 10 fig. 13, and pl. 11 fig. 4 (holotype!). Posterior leg fig. 1d. Anal appendages pl. 13 fig. 5 - 6 (fig. 5 and 5a holotype!).

Apart from the type, there is a second male in the collection of the Brussels Museum, also collected by WALLACE in the Peninsula, which does not differ from the type.

In our material of the Malaysian islands two slightly different forms can be recognized, which do not differ structurally from one another.

a). Our examples from Billiton and western Borneo are among the smallest which I have examined:

Length: ♂ abd. + app. 26 - 29, hw. 13.5 - 15.5 mm. Proportionate measurements of abdomen and hind wing: 26:14, 26.5:13.5, 28:15, 29:15, 29:15.5.

Legs capucine- to mikado-orange.

b). Slightly larger: abd. + app. 28 - 32, hw. 15.5 - 17.5 mm. Proportionate measurements: 28:15.5, 30:16, 31:17.5, 32:16, 32:17.5.

Legs rufous.

Female. — The colour-variability of the ♀ of typical *vittata* is best understood from the drawings on pls. 10 and 12. Chiefly characterized by its small size, the short processes to the posterior lobe of the prothorax, and the dull colours. The great reduction of the dark transverse band crossing the posterior ocelli, on the vertex, is noteworthy, and I have not yet seen females presenting the more contrasting colour-pattern of blackish-brown and yellow as seen in *v. acutimargo* and *v. javana*.

Thorax pale greyish- or greenish-yellow. Median thoracic band dull bronze-brown, ill-defined on both sides and at all times with a fine sprinkle of pallid spots (whence SELYS's name *atomaria*!). Sides of the thorax also mottled and sprinkled brown and yellow. Venter usually unspotted: in adult specimens from E. Borneo the ventral surface of the metepimeron presents a dark longitudinal streak on either side, parallel to the lateral border.

Legs capucine- to orange-buff. A row of squarish black dots along dorsal surface of posterior pair (or two pairs) of femora. Apices of all femora finely bordered with brown or black.

Examples of this sex from East Borneo differ from those of other localities in our collection by the body-markings being darker and better pronounced, except for the colour of the head, which is identical. The posterior prothoracic

projections are small and triangular, and their upward or forward direction is subject to individual variation. The figures 5 and 6 on plate 14 represent two examples, picked out without purpose, from the west- and east-coasts of Borneo.

Measurements. — Abd. 25 - 27, hw. < 16 - 16.5 (Sumatra); 24 - 26, 15.5 - 16 (Billiton); 25.2 - 27, 15.5 - 16.2 (W. Borneo); 25 - 28.5, 16 - 17.5 mm (E. Borneo). Proportionate measurements variable, e.g.: 24:16, 25:15.5, 26:16 (Billiton).

Copera vittata acutimargo (KRÜGER).

1898. KRÜGER, Stett. Ent. Zeitg. 59, p. 105 - 106. — ♂♀ N. E. Sumatra (*Psilocnemis acutimargo*).

1915. RIS, Tijdschr. Ent. 58, p. 7 fig. 1 - 2 (proth. ♀). — ♂ P. Babi; ♂♀ Simaloer I. (*acutimargo*).

1927. RIS, Zoöl. Meded. Leiden, 10, p. 18 (key ♂♀ Simaloer, synonymic notes) (*acutimargo*).

1935. LIEFTINCK, Misc. Zool. Sum. 92-93, p. 8 no. 35 (pars!). — lit. quoted (*acutimargo*).

Material studied: — 7 ♂, 1 ♀ from N.E. and W. Sumatra, 1 ♀ from Simaloer I. — N.E. Sumatra: 1 ♂ (ad., pinned), Eastcoast Gvt., [Serdang] labelled: "Tebbing Tinggi, [Soengei] Padang, Sumatra" (FÖRSTER's hand), "Schlüter vdt., Dr. Mauer lgt. 1895" (id.), "*Psilocnemis vittata* Selys Rasse *imbricata* Hagen" (id.), ex coll. F. FÖRSTER in the Ann Arbor Museum. 2 ♂ (ad., def.), Eastcoast Gvt. [Deli], Medan, Kp. Dadap, 14.II.1929, J. C. VAN DER MEER MOHR leg. 3 ♂, 1 ♀ (ad.), id., Deli, Medan, Saëntis Estate, 10.X.1936, L. J. TOXOPEUS leg., in the Buitenzorg Museum. Simaloer Island: 1 ♀ (semiad.), "Urwald", VII.1913, EDW. JACOBSON leg., "*C. acutimargo* Krüg.", det. F. RIS, in the Leiden Museum.

Very similar in outward appearance to *C. imbricata* though immediately distinguished from this species by the shape of the male appendages and the female prothorax.

M a l e (ad.). — Head, prothorax and thorax coloured much as in *imbricata;* humeral pale bands complete, always much wider than in that species, only little narrower than in *vittata deccanensis,* and thoracic sides marked with brown almost exactly as in the Indian race. Thorax pale-coloured ventrally, epimera occasionally with a diffuse brownish, longitudinal streak on each side of the latero-ventral carina.

Legs unicolorous carnelian-red, femora not obscured apically. Posterior two pairs of tibiae not dilated.

Abdomen coloured similarly to the other subspecies of the 'formenkreis', *e.g.* not differing from *vittata javana* (pl. 11 fig. 3), but with the basal rings narrower and interrupted on mid-dorsum (not so in semiadult examples). Segm. 9 apparently very variably coloured, either entirely black, or marked with an oval, bluish-white apical spot, which in our series of specimens may occupy the distal third at most of the dorsum. Segm. 10 and superior appendages entirely yellowish- or bluish-white; inferior pair also pale-coloured but for

the intero-basal protuberances and the outer sides on distal half of each, which are striped with black.

Anal appendages very similar to those of typical *vittata;* superiors comparatively longer and more evenly rounded interiorly (see the description in the key; the apps. of neither of our present specimens are fit for making adequate sketches).

F e m a l e (semiad., Deli and Simaloer I.). — The two examples in our collection match each other closely; both are somewhat intermediate between the pure white and the androchromatic (darkly coloured) colour-phase.

Head, thorax and abdomen coloured as on pl. 10 fig. 10 and pl. 12 fig. 2.

Posterior lobe of prothorax of very characteristic shape, quite identical in our two specimens examined (pl. 14 fig. 3).

Coxae and femora light buff, each of the latter with a row of partly confluent, sub-quadrangular black spots; tibiae and tarsi light ochraceous buff, apical tarsal joint tipped with black. Apical border of all femora black.

The basal rings and the terminal segments of the abdomen are of a delicate creamy-white tint. In the ♀ from Saëntis Estate, the 8th segment is entirely brown and the sides of 9 are almost black save for two whitish spots along the lower margin, one basal and one terminal; in the ♀ from Simaloer I., the pale colours are more extensive and better pronounced.

Length: ♂ abd. + app. 31 - 32.2, hw. 16 - 17.5; ♀ 29.5, 18 (Saëntis Est.), 28.5, 19 mm (Simaloer I.) Proportionate lengths of ♂ abdomen and hind wing, 31:16, 31.2:17, 32:16.4, 32:17.5.

This subspecies is an average larger than *vittata vittata,* from the Malay Peninsula, Billiton, Borneo and S.E. Sumatra. The ♀ is characterized by the strongly forwardly bent, triangular horns on the posterior lobe of the prothorax, whilst the ♂ is easily separated from typical *vittata* by the complete pale humeral stripes and by the thoracic colour-pattern.

Copera vittata javana, subsp. n.

Material studied: — 38 ♂, 7 ♀, from South Java. — 10 ♂ (semiad.-ad.), Mid Java, southcoast, Banjoemas Res., Kalipoetjang & Tjimerak (Dirk de Vries Bay), 200 - 400 m alt., 18-22.VII.1936, AUTHOR leg. 7 ♂, 1 ♀ (ad.), West Java, southcoast, Priangan Res., Tjitoë & Tjiastana (Tjipandak distr.), 100 - 200 m alt., 6-13.VIII & 13.IX.1935, M. BARTELS leg. 2 ♂, 6 ♀ (juv.-ad.), West Java, southcoast, Buitenzorg Res., Oedjoeng Genteng, sea-level, 26-29.III.1937 & 30.VI.1939, AUTHOR leg. — Holotype ♂ and allotype ♀: Oedjoeng Genteng, 26-29.III.1937, in the Buitenzorg Museum.

M a l e (ad.) — Head, thorax and abdomen coloured as on pl. 10 fig. 23 and pl. 11 fig. 3. Transverse pale stripe on top of head complete, pale green in fully coloured specimens. Black head-marks posterior to the ocelli variable,

usually continuous from eye to eye but very often surrounded by a pale line bordering the inner margin of the eyes. Transverse pale occipital lines invariably present.

Dorsum of pro- and synthorax deep bronzed black. Humeral stripes of variable width but never broader than on pl. 10 fig. 23. Mesepimera usually wholly black; occasionally there is a narrow yellow line joining the upper part of the humeral suture, and in some examples the mesepimerites, in addition to the shoulder-stripe, are irregularly mottled with a few pale points. Sides with blackish or pale brown, partly confluent stripes on either side of the second suture. Venter of thorax pale-coloured, unmarked.

Legs unicolorous mikado-orange. Apical border of all femora extremely narrowly obscured. Intermediate and posterior tibiae distinctly widened, posterior tibiae shaped as in fig. 1c. Posterior femur reaching apex of abdominal segment 1.

Abdomen coloured as on pl. 11 fig. 3. Dorsum of segm. 10 invariably pale green or yellow. Segm. 9 either entirely black (in the great majority of specimens), or with a small yellow spot, variable in outline, on dorsum occupying the apical ⅓ to ¼ of the segment.

Anal appendages, superior pair yellow, inferiors yellow or ochreous, striped variably with black laterally (pl. 13 fig. 4).

M a l e (juv.) — Differs from the adult male chiefly in that the juxtahumeral mesepimeral stripe is more extensive and usually somewhat broader; the mesepimerites are more conspicuously mottled with yellow. Segm. 9 of abdomen at a maximum with the apical half of the dorsum bearing a roundish yellow spot. Anal appendages entirely yellow.

F e m a l e (ad.). — Head and thorax coloured as shown on pl. 10 fig. 24-25 (extremes). Dorsum of thorax and lower ¾ of mesepimerites pitchy-black. Humeral stripes complete and sharply defined. Venter of thorax with a longitudinal, crescent-shaped, black spot on either side near the margin.

Prothorax pl. 14 fig. 4.

Legs capucine-buff to orange-buff. All femora marked exteriorly with a row of closely approximated, elongate or roundish black points, and with the apical border very narrowly obscured.

Abdomen in very old females almost black (pl. 12 fig. 3); more frequently segm. 1 - 7 are dark brown, 8 - 10 only being deep black aside; 9 with a posteriorly widened, pale bluish dorsal mark; 10 and appendages wholly pale-coloured.

F e m a l e (juv.). — Thorax deep black dorsally and laterally, with sharply delimited yellowish-white markings. Legs paler. Abdomen, segm. 1 - 7 pure white with narrow black apical rings and indistinct, sub-apical greyish spots. Terminal segments as in the adult insect (pl. 12 fig. 4).

Length: ♂ abd. + apps. 28 - 32.5, hw. 15 - 17.5 (*e.g.* 31.5, 16.5; 31.5, 17.5; 32.5, 17.5); ♀ 27 - 29.5, 18 - 18.5 mm.

D e s c r i p t i o n o f t h e f u l l - g r o w n l a r v a (fig. 2).

Total length of body without caudal gills 9.4; median gill 4.7, lateral gill 5.5; length of head 1.47, width of same across the eyes 2.96, width between occipital lobes 1.49; length of antenna 1.75 (circa). Length of hind wing rudiment 3.4; of posterior femur (excl. troch.) 2.8 mm.

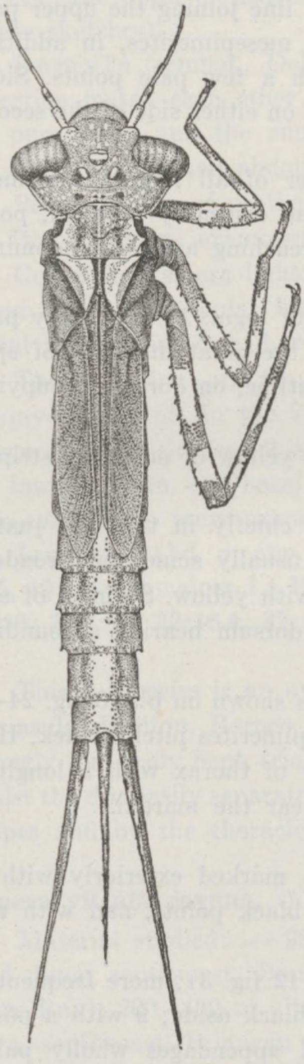


Fig. 2. — Full-grown larva of *Copera vittata javana*, subsp. n., Oedjoeng Genteng, Southwest Java.

Body Agrionine in shape, though more compactly built and abdomen shorter. Head large, wider than thorax, its length about equal to the width between occipital lobes. Eyes large, very prominent laterally and narrowly rounded. Occipital lobes very prominent posteriorly and covered with a number of short, spike-like setae. Antennae moderately long, length of separate joints 0.34, 0.33, 0.34, 0.31, 0.20, 0.15, 0.09 mm. Slightly lateral to the middle of the posterior border, at the highest point of the eyes, there rises a low pyramidal tubercle. This postocular prominence is sub-angular above and in side-view projects well beyond the highest level of the eyes.

Labium rather long and slender, adpressed to the body, hinge reaching as far back as half-way between coxae of first and second pair of legs. Mentum narrow basally, strongly and evenly widened apically. Median lobe with 6 - 7 short spinulose setae along each lateral margin; anterior part of the lobe prominent, obtuse-angulate and rounded, with a row of microscopical, squarish, marginal setae. Mental setae 2 each side, placed in a single transverse straight row. Lateral lobe with about 7 short marginal setae, apical portion divided into two unequal portions; the upper division is wedge-shaped, truncated apically and ends in four rounded prominencies, the first one being a little longer than the others; lower division with the inner margin microscopically serrulate and ending in a strong, incurvate end-hook. Lateral setae 4 each side. Movable hook long and strong, arcuate.

Prothorax flat above, with a lateral acute-angular prominence directed obliquely anterad from its postero-lateral angle; posterior border slightly keeled, rounded.

Wing-cases parallel, reaching back almost to the end of segm. 6.

Legs strong; all femora beset with a row of 5 - 7 very short, spinulose dark setae along their posterior edges.

Abdomen short; lateral spines on 6 - 10, increasing in length and prominence posteriorly and with a cluster of spinules on 10 externally at the base of the lateral gill.

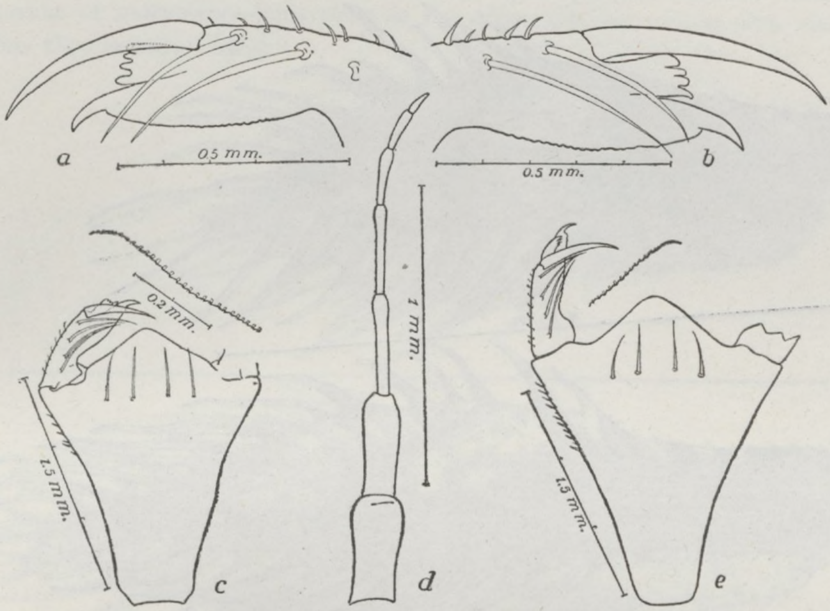


Fig. 3. — Larval structures of *Copera vittata javana*, subsp. n. (a, c and d), and of *C. marginipes* (RAMB.) (b and e). — Inner view of lateral lobe of labium (a - b), of labium (c and e), and left antenna (d).

Caudal gills shorter than abdomen, lamellar, of the denodate vertical type [1]), oblanceolate. Median gill much shorter than the two lateral ones, slightly bent, basal portion only little narrowed, widest at mid-way its length and from there strongly fimbriate, pointed. Lateral gills elongate, straight; lateral carina obtuse, outer surfaces with 5 - 6 irregularly distributed, very short, tooth-like setae. All gills heavily pigmented, semi-opaque, crossed by three very irregular and partly confluent, oblique, transverse bands of a chocolate-, purplish- or seal-brown tint. Main tracheae of gills indistinct, tracheal system only visible in places, secondary tracheae irregularly branched.

C o l o r a t i o n. — Dark blackish-brown variegated with pale yellow-brown on the pro- and mesonotum. Head pale brown, mottled with darker brown. Antennae pale-coloured; second joint indistinctly ringed with brown. Thoracic sides and wing-cases brownish-black.

Legs pale reddish-ochreous; basal third of anterior femora sharply defined dark brown or blackish.

Abdomen light brown, indefinitely and longitudinally striped with dark brown.

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[1]) R. J. TILLYARD, Proc. Linn. Soc. N. S. Wales, 42, 1917, p. 98.

The above description of the larva of *C. vittata javana* may serve to the easy recognition of not only this species but also of *C. marginipes* (RAMB.); and, quite probably, of *C. imbricata* (SELYS) as well.

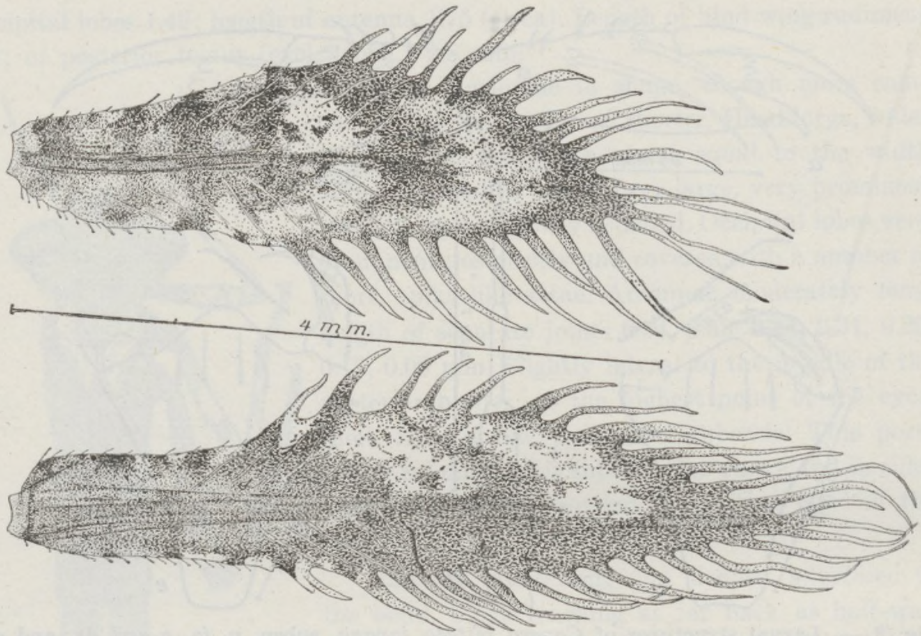

Fig. 4. — *Copera vittata javana*, subsp. n. Median and left lateral caudal gill of full-grown larva from Oedjoeng Genteng, Southwest Java.

Some brief notes on the larva of *C. marginipes* have been published by FRASER [1]), who also gave outline-figures of the insect and its labium. The description and sketches as offered by NEEDHAM [2]) are more accurate and correspond well with the above description of *vittata*.

The larva of *C. marginipes* is found almost everywhere in slowly running waters such as brooks flowing through bamboo-groves and *Metroxylon* bushes. This species is also quite common in cultivated areas, breeding in jungly wells, tanks or small streams in native gardens, rubber plantations, &c. The larvae are found among rotten leaves, débris and roots.

C. vittata, however, breeds exclusively in small streams in dense jungle, or in trickles flowing through forest-marshes [3]).

The larvae of *marginipes* and *vittata* are very similar in appearance. They are easily recognised from other zygopterous larvae by the curiously fringed gills; and, as FRASER [4]) justly remarks, "The larva makes a fuller use of its caudal gills than most species and is to be seen clinging to roots in rapid flowing

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[1]) F. C. FRASER, Rec. Ind. Mus. 16, 1919, p. 464 - 465, pl. 35, fig. 3, pl. 37 fig. 6.
[2]) J. G. NEEDHAM, Zool. Sinica (Peiping), 11, 1930, p. 250 - 251, pl. 18, fig. 2, 2a.
[3]) Some notes on the breeding-place of *C. vittata javana* at Oedjoeng Genteng, on the south-coast of Java, are contained in the writer's previous paper (Treubia, 17, 1939, p. 50 - 51).
[4]) F. C. FRASER, Rec. Ind. Mus. 26, 1924, p. 498.

streams, its gills erect over its back and swayed constantly from side to side in the current. At the approach of danger it lowers the gills and lies flush on its resting place or manoeuvres this between itself and the point of danger".

Larvae of *marginipes* kept alive in the aquarium for a long time did not abandon this peculiar habit.

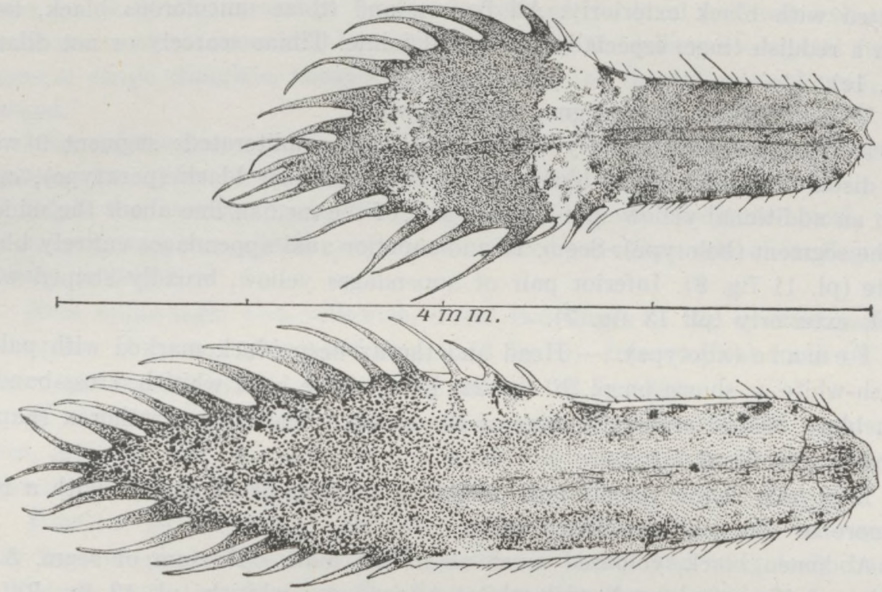


Fig. 5. — *Copera marginipes* (RAMB.). Median and right lateral caudal gill of full-grown larva from Buitenzorg, West Java.

There are only few points of distinction between the larvae of these two species. As is shown on fig. 3, the armature of the mask is almost identical and the difference found in the proportions of the head are so slight as to be almost negligible:

Greatest width over the eyes	2.96 (*marg.*),	2.83 (*vitt. javana*).
Length of head (median line)	1.56 „	1.47 „
Width between occipital lobes	1.49 „	1.42 „

The slight differences in the shape of the caudal gills are elucidated by the accompanying sketches (fig. 4 and 5).

Copera vittata palawana, subsp. n.

Material studied: — 2 ♂, 1 ♀ (ad.), Palawan I., Alfonso XIII, 6.V.1935, K. KUWASIMA leg. Holotype ♂ and allotype ♀ in the Leiden Museum.

M a l e. — Labium pale yellow. Mandible-bases, labrum and genae yellow. Anteclypeus yellow-brown. Head black, marked with pale blue as shown on pl. 10 fig. 20 - 21; rear black with a yellow spot close to the eye-margin. Antennae blackish-brown.

Prothorax black with some confluent pale blue spots on each side of the middle, placed in line with the humeral stripe.

Synthorax dark bronzed black, marked with blue as shown on pl 10 fig. 20 (paratype). In the holotype (pl. 10 fig. 21) the blue marks are somewhat more extensive and partly confluent. Venter of thorax yellow with a sharply delimited, elongate, deep black spot on each side near the margin of the metasternum.

Coxae pale bluish, somewhat obscured laterally; trochanters yellowish, spotted with black exteriorly. All femora and tibiae unicolorous black, tarsi with a reddish tinge, especially the apical joints. Tibiae scarcely or not dilated (fig. 1e).

Wings hyaline. Pterostigma dark brown.

Abdomen almost entirely black. Basal rings obliterated; segment 9 with the distal one-third bright bluish-white, the remainder black (paratype), or 9 with an additional yellow spot on each side of the median line about the middle of the segment (holotype). Segm. 10 and superior anal appendages entirely blue-white (pl. 11 fig. 8). Inferior pair of appendages yellow, broadly striped with black exteriorly (pl. 13 fig. 7).

Female (allotype). — Head and thorax deep black marked with palest bluish-white as shown on pl. 10 fig. 22. Rear of the head whitish, cross-banded with black behind occiput. Venter of thorax as in the male. Prothorax shaped as on pl. 14 fig. 7.

Legs pale yellow (cream-buff); exterior surfaces of all femora with a row of more or less confluent black spots.

Abdomen black, coloured much as in the male. Dorsum of segm. 8 - 9 partly, of 10 entirely yellowish-white. Appendages whitish (pl. 12 fig. 9).

Length: ♂ abd. + app. 29.5 (type), 29.8 (paratype), hw. 17 (type), 16.5 (paratype); ♀ 28.5, 18 mm.

Copera imbricata (SELYS).

1863. SELYS, Bull. Acad. Belg. (2) 16, p. 171 - 172. — ♂ Padang, W. Sumatra (*Psilocnemis*).

1898. KRÜGER, Stett. Ent. Zeitg. 59, p. 106 - 107. — ♂♀ N. E. Sumatra (*Psilocnemis lobimargo*).

1907. FÖRSTER in LAIDLAW, Fasc. Malay. Zool. 4, p. 7 (note) (*Psilocnemis lobimargo*).

1927. RIS, Zoöl. Meded. Leiden, 10, p. 17 - 19 (key ♂♀, remarks on synonymy), fig. 9 (proth. ♀). — ♂♀ Centr. W. Sumatra, Ophir distr., Padangsche Bovenlanden) (*lobimargo*).

1935. LIEFTINCK, Misc. Zool. Sum. 92 - 93, p. 8 no. 35 (pars !), no. 37. — S. Sumatra (Lampoeng Res.) (*acutimargo*), lit. quoted (*lobimargo*).

Material studied: — 42 ♂, 8 ♀ from W. and S. Sumatra. — 1 ♂ (semiad., in good condition, legs mostly missing), indicated as type on a triangular pin-label by a black cross-mark, under the (erroneous!) yellow drawer-label: "*serapion* Hag., *Platycnemis*, Java, Jngh." (JUNGHUHN?) (unknown hand), type of *Psilocnemis imbricata* HAGEN-SELYS, in the Halle Museum. 2 ♂ (ad.), West-coast Res., Ophir distr., Moeara Kiawai, VI.1915, E. JACOBSON leg., in the Leiden Museum. 2 ♂, Benkoelen Res., Tandjong Sakti, 600 m alt., 1.VI - 19.VII.1935,

M. E. WALSH leg. 4 ♂, 2 ♀, Lampoeng Res., Mt. Tanggamoes, Giesting, 600 m alt., 17.VI - 10.VII.1934, L. J. TOXOPEUS leg. 33 ♂, 6 ♀, same locality, Wailalaän & Waiteboe, 24.XII.1934 - 3.I.1935, AUTHOR leg.

Male (semiad., holotype). — Head, thorax and abdomen coloured as shown on pl. 10 fig. 6, and pl. 11 fig. 2. Rear of the head pale-coloured, with a continuous black transverse band to the rear of the pale postoccipital fascia. Humeral stripe complete, though narrow. Venter of thorax pale-coloured, unmarked.

Legs unicolorous carnelian-red (semiadult!), femora not obscured apically. Posterior two pairs of tibiae not noticeably dilated (fig. 1f).

Segm. 9 of abdomen with three diffuse pale spots: one ante-apical, mid-dorsal spot, and two slightly larger ones, placed on either side of it. Segm. 10 entirely yellowish.

Anal appendages also yellowish, distal two-thirds of the exterior surfaces and apices of inferior pair blackish (pl. 13 fig. 3). Intero-apical tooth of superior appendage similar to the one figured (pl. 13 fig. 8a).

Male (ad., Lampoeng). — A uniform series of comparatively large specimens, differing from the type only in details of coloration and in the slightly shorter inferior appendages.

Humeral stripes slightly variable in width, always complete but usually very narrow (pl. 10 figs. 7 - 8). Metapleurae variably and irregularly banded with dark brown as shown in the figures; venter always unmarked.

Legs orange-buff to capucine-orange in matured examples. Apices of all femora invariably, though narrowly, bordered with black; tarsal joints slightly obscured apically. Hind tibia (fig. 1g).

Abdomen mostly black; basal rings of segm. 3 - 6 sharply pronounced, interrupted mid-dorsally, creamy-white. Segment 9 entirely black in full-coloured specimens, the membrane between 8 and 9 brownish. Segm. 10 bluish-white to bright green in living specimens, occasionally with a narrow, black, dorsal basal line.

Anal appendages, superior pair at first greenish-white, growing darker with age until they become entirely brownish-black in adult individuals, only the extreme apices being yellowish. Inferior pair black, distal half of inner surfaces brownish. Intero-basal tooth of superior appendages black, shaped as on pl. 13 fig. 8, 8a.

N.B. — The two specimens from Moeara Kiawai (Ophir distr.), and the males from Benkoelen as well, do not differ from the above described series from South Sumatra, except that the inferior appendages of the Ophir specimens are relatively a little shorter than in the others. The ratios are: 1:2.1 (type *imbricata*), 1:2.3 (Ophir distr.), 1:2.4 - 1:2.5 (Lampoeng distr.). The Ophir males are not fully adult and match the type of *imbricata* very closely. Although I have not seen KRÜGER's type of *lobimargo* from N.E. Sumatra, it is evident

from his description of the colour of the 9th abdominal segment, that most of his specimens were immature ("1 reifes ♂, 5 junge von Soekaranda"; "das 9. und 10. Segment des Abdomen weisslich").

Female (ad., Lampoeng). — Colour-pattern of head and thorax generally as on pl. 10 fig. 9. Ground-colour of the thorax cinnamon-buff dorsally, fading to pinkish-buff laterally. Labrum, base of mandibles, and genae partly, light green to light orange-yellow.

Prothorax dull yellowish above, variably mottled with brown, sides deep black. Posterior lobe mainly yellowish (pl. 14 fig. 8).

The bronzed green median band on the dorsum of the thorax varies in width; usually it is shaped as on pl. 10 fig. 9, but occasionally it is much narrower, tapering considerably ventrally, after the slight constriction below its middle. The outer border of this band is rather irregular, caused by the intrusion of the pale ground-colour. Upper half of the mesepimera always unmarked. Sides variably mottled with brown; metepimeral dark spots comparatively small and linear, or spot-like, whether or not confluent. Venter pale.

Legs, including the coxae, light ochraceous-buff; femora and tibiae rarely more vividly coloured, at most light orange-yellow; femora with a small apical spot of black along margin, and with the exterior surfaces striped in such a way as to show a complete row of narrowly interrupted, squarish black spots, which are at times coalescent, or nearly so.

Abdomen lighter to darker brown, segments progressively darker from before backwards. Pale basal rings on segm. 3 - 6 (pl. 12 fig. 10) very narrow though sharply defined, whitish or light green, interrupted mid-dorsally, obscured or barely traceable on 4 - 6 in very matured individuals. Terminal segments black. Segm. 9 usually with a roundish dorsal sub-apical bluish-white spot; 10 and anal apps. entirely blue-white. Valves brown to almost black.

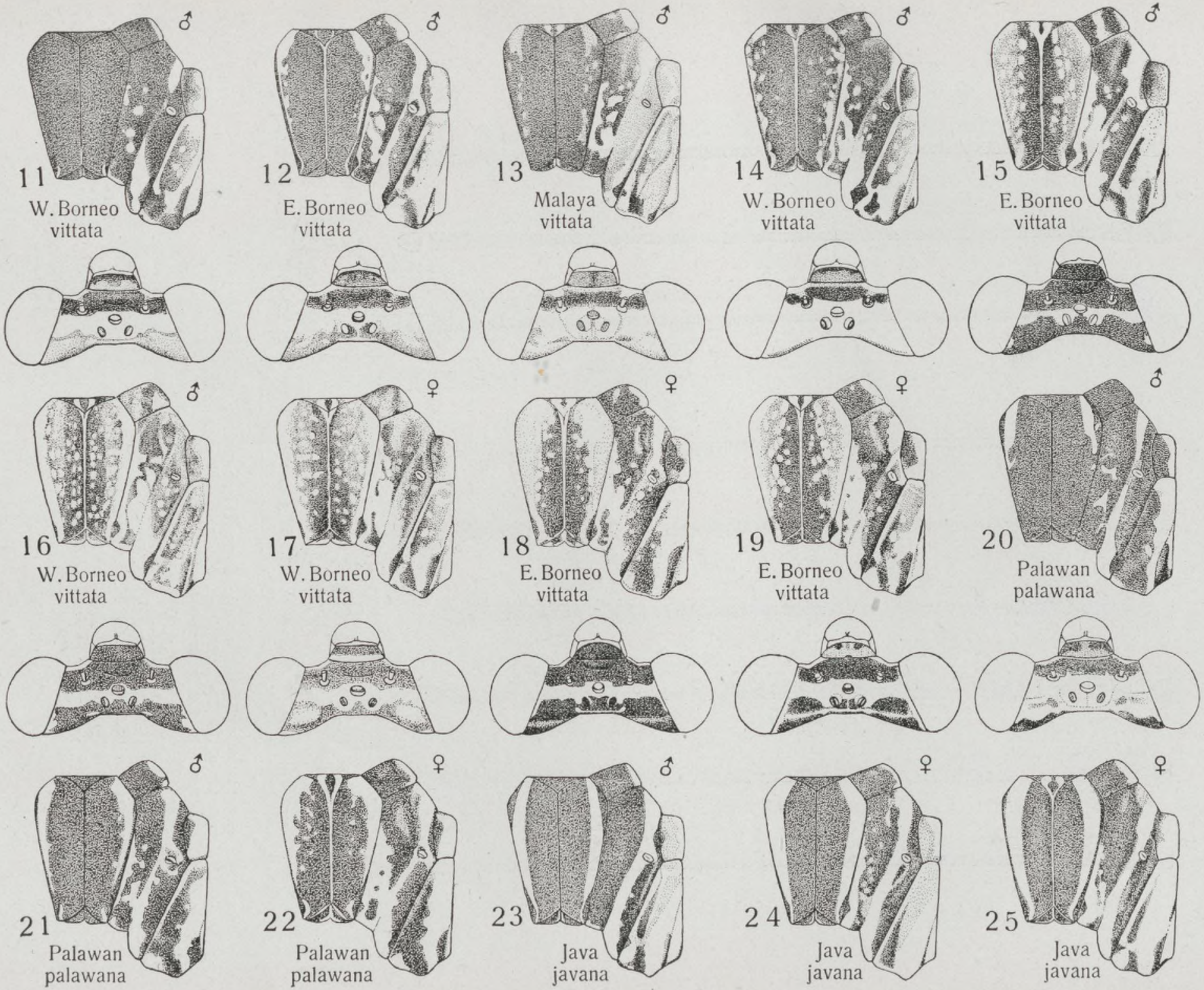
Size as well as proportions very variable. Length: ♂ abd. + app. 29, hw. 16.3 (type Padang); 28 - 33.2, 16 - 18.5 (Lampoeng); 29, 16.2 (Benkoelen); ♀ 27 - 30, 17.8 - 20 mm (Lampoeng). Proportionate lengths of abdomen and hind wing, *e.g.:* 28:16, 29:16.2, 30:17.4, 31:17, 31.5:18.3, 32.2:18, 32.5:8, 33.2:18.5 (♂ Lampoeng); 27: 18, 27.3: 18, 28.2: 17.8, 30: 20 mm (♀ Lampoeng).

A stream-dwelling species. Very common in the southern districts of Sumatra, and although chiefly restricted to jungly areas, found also in cultivated tracts, often in company with *marginipes.*

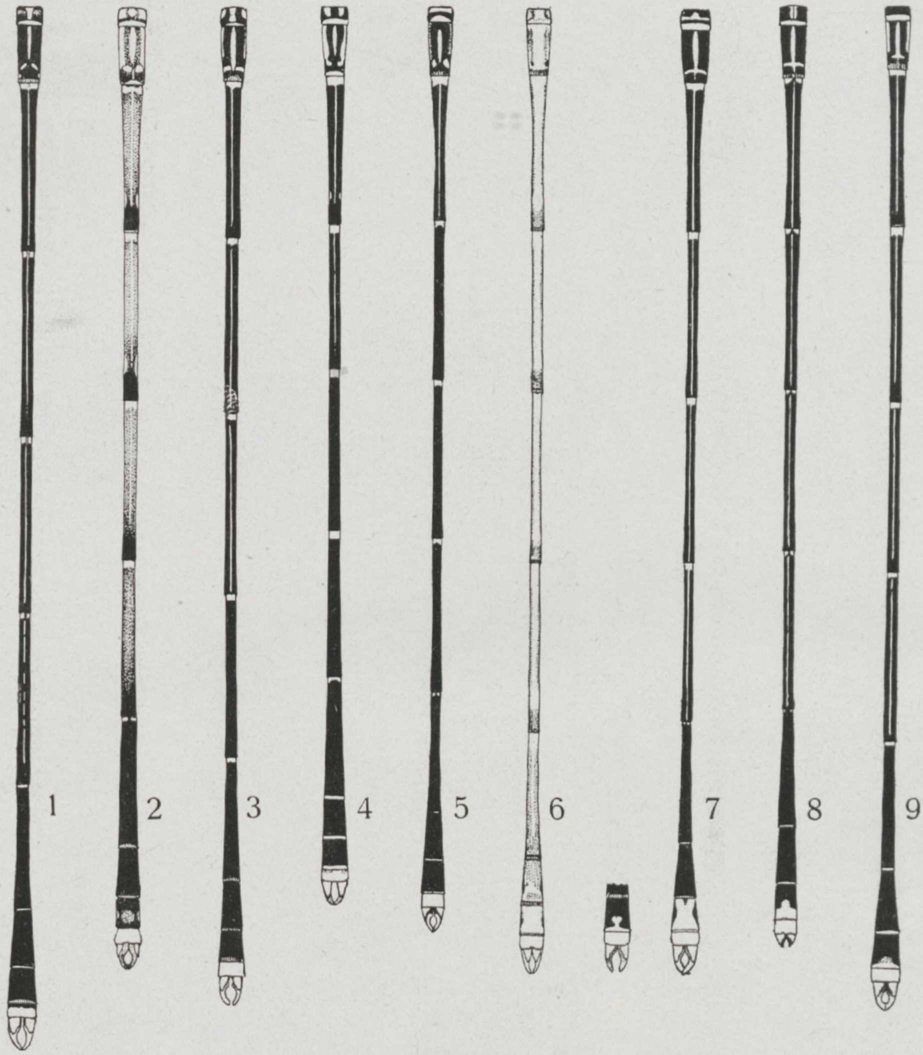
Unlike *C. vittata,* which is generally found in the deltaic regions of the large rivers of Malaysia, the known distribution of *C. imbricata* seems to indicate rather a sub-montane habitat (see map).

The interest of the South Sumatran collection lies in the fact that it has added materially to our knowledge of the geographical distribution of many of the common species of the island.

Pl. 10. — Colour-pattern diagrams of head and synthorax of *Copera*



vittata (Selys) and its subspecies, and of *C. imbricata* (Selys).

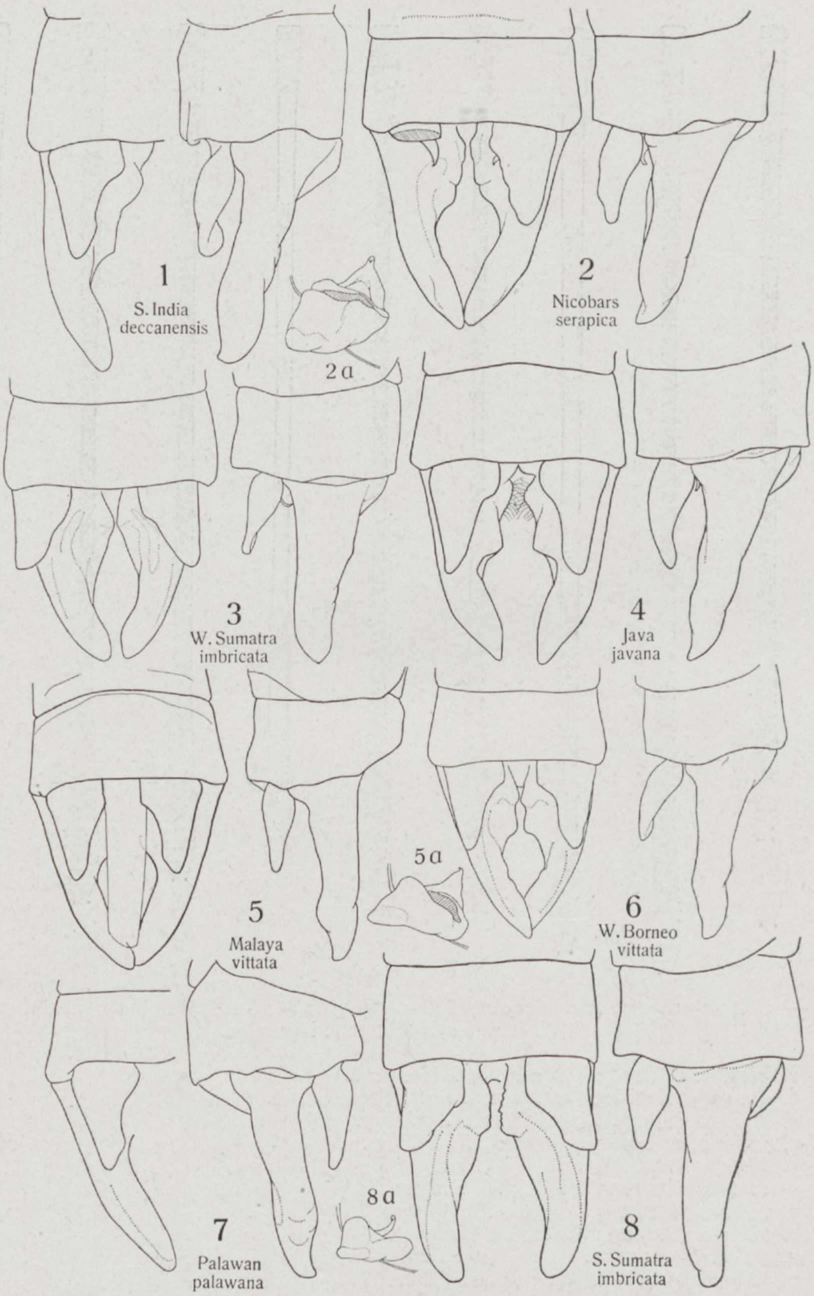


Pl. 11. — Colour-pattern of abdomen of *Copera vittata* (SELYS) and its subspecies, and of *C. imbricata* (SELYS). Males.

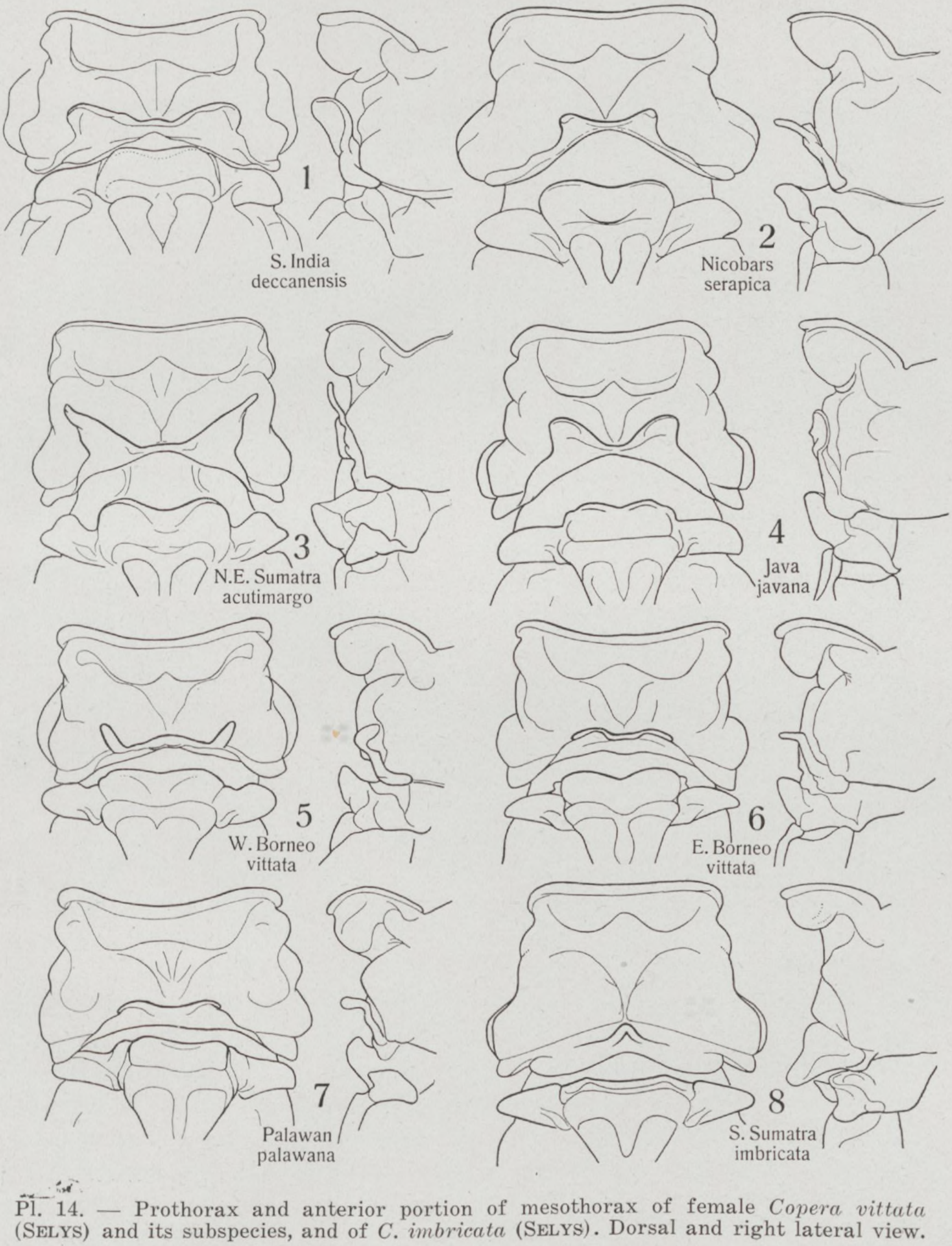
1. *C. v. serapica* (SELYS), lectoholotype, Nicobar I.
2. *C. imbricata* (SELYS), holotype, Padang, W. Sumatra.
3. *C. v. javana*, subsp. n., holotype, S. W. Java.
4. *C. v. vittata* (SELYS), holotype, Malaya.
5. *C. v. vittata* (SELYS), adult, W. Borneo.
6. *C. v. vittata* (SELYS), teneral, W. Borneo.
7. *C. v. vittata* (SELYS), adult, E. Borneo.
8. *C. v. palawana*, subsp. n., paratype, Palawan I.
9. *C. imbricata* (SELYS), adult, S. Sumatra.

Pl. 12. — Colour-pattern of abdomen of *Copera vittata* (SELYS) and its subspecies, and of *C. imbricata* (SELYS). Females.

1. *C. v. serapica* (SELYS), allotype, Nicobar I.
2. *C. v. acutimargo* KRÜGER), semi-adult, Simaloer I.
3. *C. v. javana*, subsp. n., adult, S. W. Java.
4. *C. v. javana*, subsp. n., teneral, S. W. Java.
5. *C. v. vittata* (SELYS), adult, W. Borneo.
6. *C. v. vittata* (SELYS), adult, W. Borneo.
7. *C. v. vittata* (SELYS), teneral, E. Borneo.
8. *C. v. vittata* (SELYS), adult, E. Borneo.
9. *C. v. palawana*, subsp. n., allotype, Palawan I.
10. *C. v. imbricata* (SELYS), adult, S. Sumatra.



Pl. 13. — Anal appendages of male *Copera vittata* (SELYS) and its subspecies, and of *C. imbricata* (SELYS). Dorsal and lateral view. Figs. 2a, 5a and 8a, right superior appendage, seen from behind, showing inferior basal projection.



Pl. 14. — Prothorax and anterior portion of mesothorax of female *Copera vittata* (SELYS) and its subspecies, and of *C. imbricata* (SELYS). Dorsal and right lateral view.

A PRELIMINARY INVESTIGATION OF THE SPAWNING HABITS OF SOME FISHES OF THE JAVA SEA

by

Dr. J. K. DE JONG

(Buitenzorg).

INTRODUCTION.

In 1936 HICKLING and RUTENBERG published a paper in which they developed the hypothesis that the investigation of a nearly ripe ovary may provide information as to the spawning habits of fishes.

"It has occured to us that measurements of the diameters of eggs in ovaries well advanced towards spawning may give evidence of the duration of spawning in a fish of which the spawning habits are unknown. For where the spawning period is short and definite, the batch of transparent yolkless eggs, destined to mature and be spawned, will be withdrawn from the general egg-stock in a single group, sharply distinguishable, at least in the later stages of maturation from the stock of small egss from which it was derived. But when the spawning period is long and indefinite the withdrawal of eggs from the egg-stock, to undergo maturation, will be a continuous process, and there will be no sharp separation between the general egg-stock and the maturing eggs. These will pass continuously one into the other." (HICKLING & RUTENBERG p. 311).

The idea laid down in this publication forms the base of our present investigation. The spawning habits of the fishes of the Java Sea are entirely unknown and by applying HICKLING and RUTENBERG's methods it might be possible to throw some light on this problem.

We must however emphasize that the view, according to which the investigation of a few specimens will reveal to us the spawning habits of the species is very optimistic. It is true that when there is no sharp separation between the young and the maturing eggs, we are allowed to conclude that the spawning of the species is long and indefinite, but on the other hand, if the different batches of maturing eggs are sharply separated from each other, the conclusion that the spawning period of the species is short seems rather premature.

The question clearly involves a double problem. It is obvious that if a species will show a short and definite spawning period, a well defined periodicity in the maturation of the eggs in the single individual is a prime requisite. But at the same time it is evident that still a second condition will be realized when the spawning period of the species is short. This second condition is the more or less synchronous spawning of all the individuals of the same species.

Conditions in tropical seas make it rather probable that specimens which contain ripe ovaries will be found throughout the year, so that a periodicity in the individual may be obliterated in the species as a whole.

Notwithstanding this it is possible that the bulk of the individuals may spawn within a short and definite period, so that, although fishes with a ripe ovary may be found in every season, the species as a whole may show a rather definite periodicity.

Apart from the time factor the problem of the periodicity of the spawning of the single individual may be solved with a little luck by the investigation of one specimen. To investigate the spawning habits of the species, systematic observations for at least 12 months are necessary to enable us to form definite conclusions.

This paper mainly deals with the first part of the problem, but although the observations cover four months only, it it possible to discuss at least for some of the species under observation the second part of our question, the spawning habits of the species as a whole.

MATERIALS AND METHODS.

This investigation includes 13 species viz:

		native name:
1.	*Stromateus niger* BLOCH.	B a w a l.
2.	*Caesio erythrogaster* (K. v. H.) C. V.	E k o r k u n i n g.
3.	*Clupea fimbriata* (C. V.)	T e m b a n g.
4.	*Decapterus russelli* (RÜPP.)	L a j a n g.
5.	*Caranx leptolepis* C. V.	S e l a r k u n i n g.
6.	„ *mate* C. V.	„ t j o m o.
7.	„ *malam* (BL.)	„ m a l a m.
8.	„ *crumenophthalmus* BLKR.	„ b e n t o n g.
9.	*Lactarius lactarius* (BL. SCHN.)	I k a n l e m a h.
10.	*Scomber neglectus* v. KAMPEN	K e m b u n g p e r a m p u a n.
11.	„ *kanagurta* (RUSSELL)	„ l e l a k i.
12.	*Scomberomorus* spec.	T e n g g i r i.
13.	*Euthynnus allitteratus* RAFINESQUE ...	T o n g k o l.

From many of these fishes I was able to gain a good insight into the spawning habits. Of some species the data are incomplete.

In nearly every case the fishes were bought, during the months of February-May 1939, at the fish market, Pasar Ikan, at Batavia. They therefore belonged to the usual commercial catches. Some species were completely fresh, that is to say, the fish had been caught over night and brought to the market as soon as the sea breeze allowed the native prahus to enter the harbour. Other species, on the contrary, were caught higher at sea and had been stored for one or more days on ice. As a rule, with the exception however, of both t e m b a n g and

l a j a n g, the preservation was good enough to make a microscopical investigation possible.

The ovaries were in all cases fixed in BOUIN's fluid (picric-acid, saturated aqueous solution 75 parts, formol 25 parts, acetic acid 5 parts) for about 20 hours. Then they were transferred to 70 per cent alcohol. Parts of the ovaries were then treated in the customary way through xylol into paraffin, to be cut into sections. As a rule no serious difficulties were experienced, although in many cases the yolk material was rather hard. In one or two cases where nearly ripe eggs were included it was necessary to cut down the time during which they stayed in xylol and in the hot paraffin.

The ovaries were then cut into sections of 10 μ and stained with EHRLICH's haematoxylin and eosin. The diameters of the eggs were measured by means of a micrometer eyepiece in a compound microscope at a magnification which gave a value of 17.2 μ to each micrometer unit. In the following graphs the diameters of the eggs are given in micrometer units.

To make sure that the eggs had been cut approximately at their maximum diameter, only those eggs were measured in which a nucleus was visible.

In this study ovaries of fish which have never spawned are designated as young. Individuals which have spawned or are approaching their first spawning season are adult. Mature or ripe is the egg which has burst or is ready to burst from the follicle. An ovary containing such eggs is called ripe or mature.

I would here express my thanks to Dr. J. D. F. HARDENBERG, head of the „Laboratorium voor het Onderzoek der Zee", and to Dr. J. REUTER of the „Instituut voor de Zeevisscherij" Pasar Ikan Batavia, for many valuable suggestions and for their help in procuring the material; to Prof. Dr. L. G. M. BAAS BECKING, Director of „'s Lands Plantentuin" Buitenzorg, for reading the manuscript.

GENERAL REMARKS.

In the ovary of the adult fish we find a stock of small yolkless eggs, the cytoplasm of which stains deeply with haematoxylin. From this general egg-stock quota are withdrawn to be matured and finally spawned. The way in which this happens may vary in the different species and forms the subject of the present investigation.

In maturation the eggs undergo some changes, which in the fixed and stained material become evident not only by the increasing size, but more clearly still by the changing of the colour. Gradually the original deep violet-blue becomes lighter and assumes a purple hue due to the developing of yolk.

As this granular yolkmass increases, the cytoplasm retires to the periphery, contracting to a sort of disc. The colour of the stained egg is now orange-red and remains so until the ultimate stages, when the eggs in the fresh ovary change to the naked eye, from opaque to hyaline. In the stained material the colour of these hyaline eggs is pale red while the yolk granules have disappeared and are fused to a homogeneous mass. At this stage

the egg follicle bursts and the egg comes free into the lumen of the ovary. Due to the effects of preservation the eggs when measured were seldom perfectly symmetrical. Therefore, to obviate any selection of the longest or shortest diameter the micrometer was placed in a horizontal position and the diameter of the egg was measured parallel to the graduations of the micrometer. This gave measurements of the longest diameters of some eggs, of the shortest of others, or measurements between these two. CLARK (1934, 1925) found this a reliable procedure and very satisfactory for constant use and I fully agree with her. The consequence of this method is however that in the frequency polygon of the diameters of the ova, the differences between two groups of eggs appear less than they are in reality. Indeed in some cases the largest diameter of an egg of the group of the younger eggs exceeded the smallest diameter of an egg of an older group. On considering the different graphs we must thus bear in mind that, if two groups of eggs are connected by a few ova of intermediate size, this connection as a rule does not exist and both groups are very clearly separated during life.

As a matter of fact it was always perfectly easy to discern whether the egg was a large representative of a young or a small one of an older group, as the colour of both groups usually differed considerably.

The group of 2 micrometer divisions contains all the eggs smaller than 2.5 mic. div.

Of each individual fish about 500 eggs were measured. It turned out that this number was sufficient to give an adequate representation of each group of eggs. Thus during this investigation the diameters of more than 60000 eggs were measured. By each species is mentioned how many specimens were used but in composing the figures the frequency polygons of only a few individuals were selected. We might have combined many of our graphs so as to give one figure, with the result that the curve would smooth down considerably, but it was not always easy to select individuals of exactly the same state of maturity. Besides, this procedure tends to obscure or even obliterate some peculiarities of the curves. The following examples taken from Selar bentong and Ikan lemah illustrate this point.

In figure 1 we find the frequency polygons of four different individuals of Selar bentong of almost exactly the same state of maturity. A, B and C belonged to one single catch and were fixed immediately (at sea) in BOUIN's fluid wherein they stayed for about 48 hours. D was bought at the fish market and treated in the accustomed way. Between A, B and C there is hardly any difference at all. C seems to be a trifle younger than A and B. In D the total number of ripening eggs is smaller than in either A, B or C, but the shape of the curve, demonstrating a peak at micr. div. 17 remains materially the same.

If we now compare these four polygons with the one we obtain by combination, we see that, although the curve may be more smooth and thus suggest a greater reliability, we have not only gained nothing by this procedure, but have lost the difference between A, B and C on one side and D on the other.

Although the number of the eggs in the different categories have no absolute value, the lower peak in D, as compared to that of the other curves is, nevertheless, very real. It means, that in specimen D the batch of maturing eggs is smaller than in the other specimens. One look through the microscope at the cross-sections of the ovaries of these specimens is sufficient to confirm this.

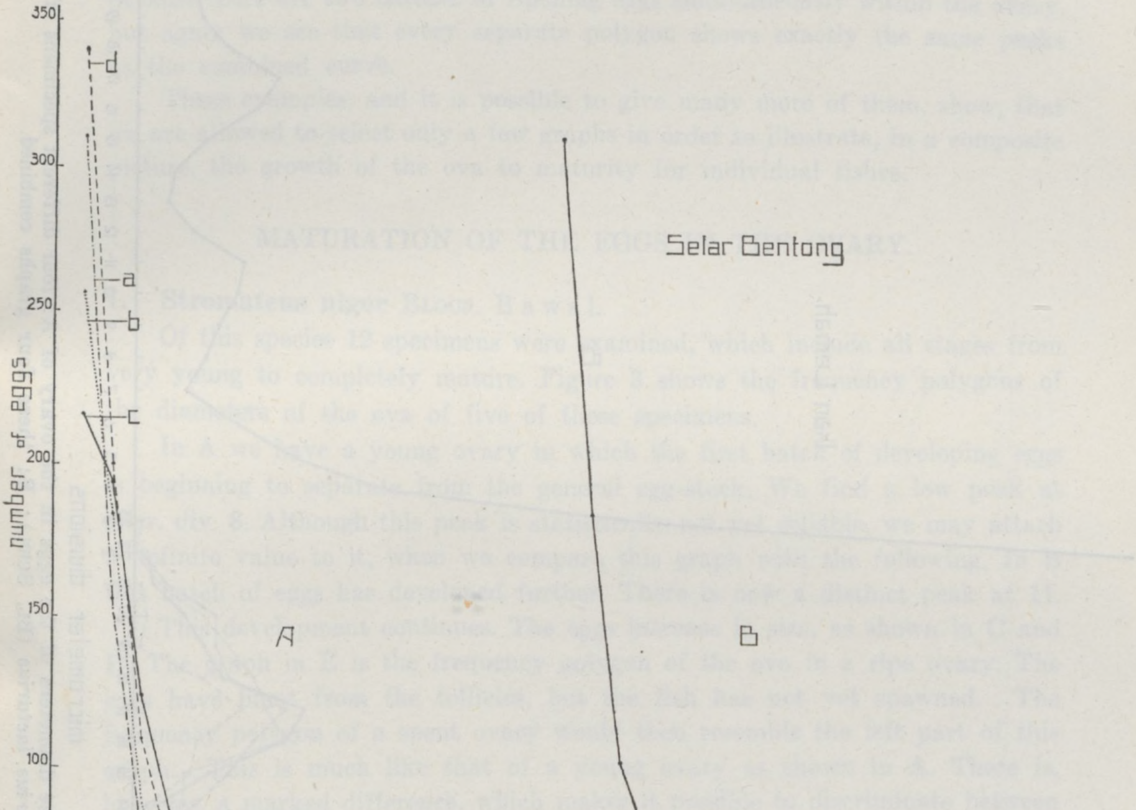


Fig. 1. — Frequency polygons of the diameters of the eggs in the ovary of A: four different specimens of S e l a r b e n t o n g, *Caranx crumenophthalmus* Blkr.; B: these four graphs combined.

As the question of the absolute magnitude of the batch of eggs ripening in each period does not fall within the scope of this investigation, we shall only draw attention to this point. It may be due to differences in the age of

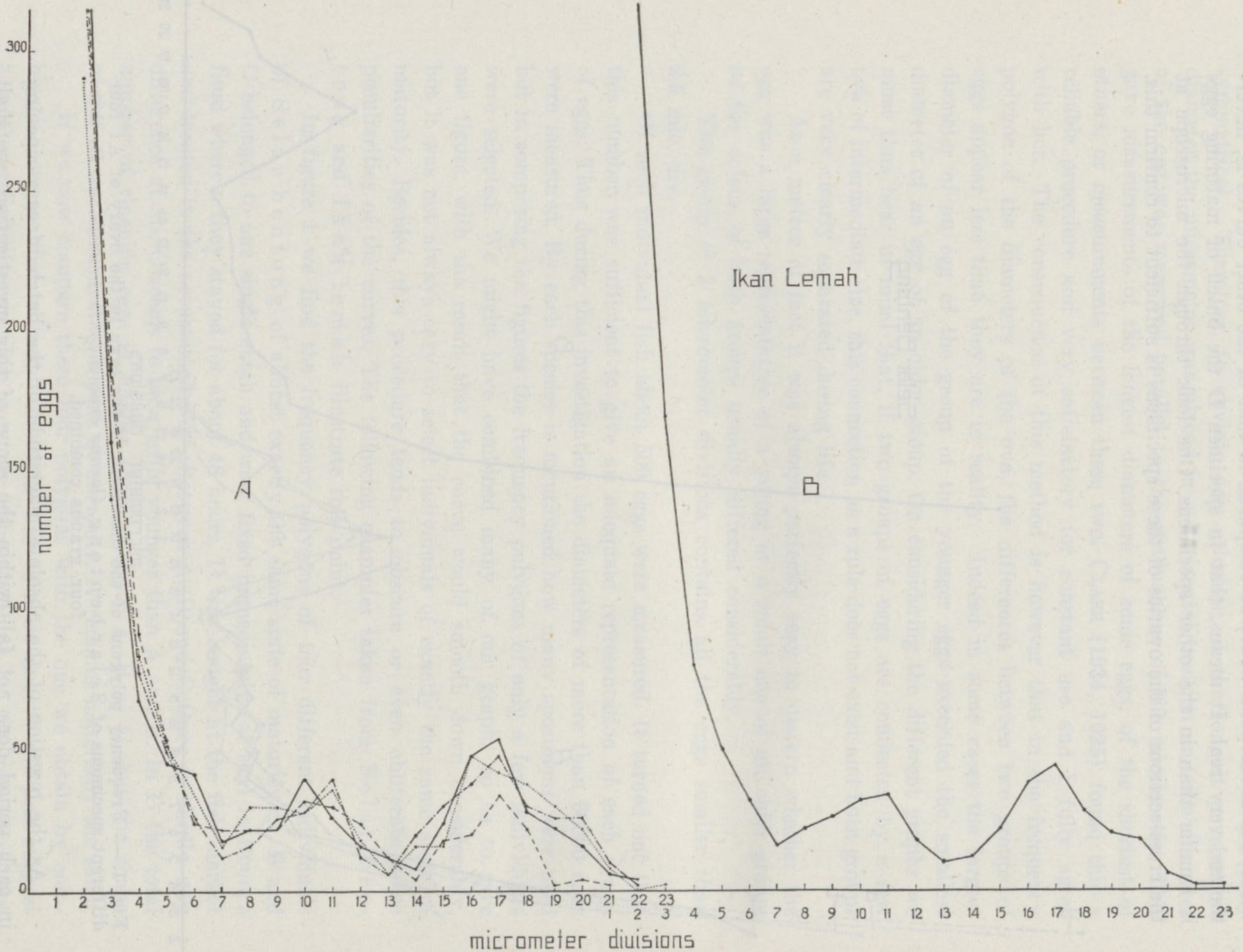


Fig. 2. — Frequency polygons of the diameters of the eggs in the ovary of A: four different specimens of Ikan lemah, *Lactarius lactarius* (BL. SCHN.); B: these four graphs combined.

the fishes, it may also be due to favourable or unfavourable food conditions or other environmental factors during the time that the batch separates from the original egg-stock.

A similar case is shown in figure 2 where the frequency curves of four specimens of Ikan lemah are given. The polygons are more complicated because there are two batches of ripening eggs simultaneously within the ovary, but again we see that every separate polygon shows exactly the same peaks as the combined curve.

These examples, and it is possible to give many more of them, show, that we are allowed to select only a few graphs in order to illustrate, in a composite picture, the growth of the ova to maturity for individual fishes.

MATURATION OF THE EGGS IN THE OVARY.

1. **Stromateus niger** BLOCH. Bawal.

Of this species 12 specimens were examined, which include all stages from very young to completely mature. Figure 3 shows the frequency polygons of the diameters of the ova of five of these specimens.

In A we have a young ovary in which the first batch of developing eggs is beginning to separate from the general egg-stock. We find a low peak at micr. div. 8. Although this peak is statistically not yet reliable, we may attach a definite value to it, when we compare this graph with the following. In B this batch of eggs has developed further. There is now a distinct peak at 11.

This development continues. The eggs increase in size, as shown in C and D. The graph in E is the frequency polygon of the ova in a ripe ovary. The eggs have burst from the follicles, but the fish has not yet spawned. The frequency polygon of a spent ovary would then resemble the left part of this graph. This is much like that of a young ovary as shown in A. There is, however, a marked difference, which makes it possible to discriminate between a young ovary and that of a fish which has just spawned. The difference lies in the presence of larger eggs in the older ovary. It is not easy to find out if these eggs belong to the new developing batch and are only fast growing representatives, or that they are lagging behind and belong to the batch that has already left the ovary. If the latter is the case (and this is the most probable explanation) these eggs will ultimately be resorbed, without coming to maturity. This resorption of eggs could not be observed in the Bawal. It is however a very common phenomenon in many other species and it will be discussed at some length in the description of the development of the eggs of the Kembung species.

Figure 3 thus shows us clearly that in the Bawal one batch of eggs separates from the general egg-stock. These ova increase in size, reach maturity and are ultimately spawned. In the mean time in the general egg-stock hardly any changes take place. The curve E suggests that as soon as the ripe eggs

have left the follicles a new batch of eggs begins to develop. However, the low peak at micr. div. 9 in E seems far from being statistically significant.

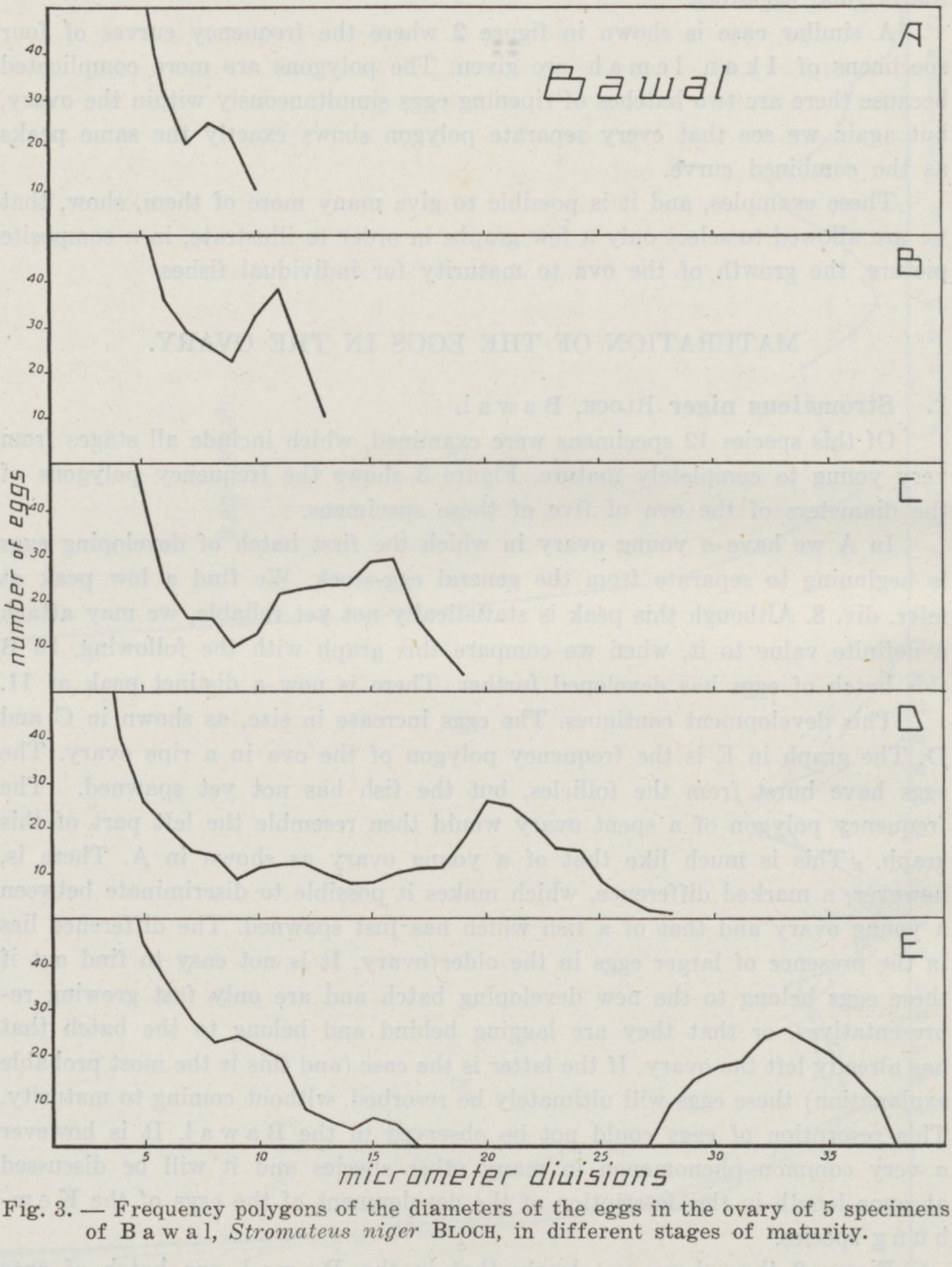


Fig. 3. — Frequency polygons of the diameters of the eggs in the ovary of 5 specimens of B a w a l, *Stromateus niger* Bloch, in different stages of maturity.

Egg-development in the B a w a l is, therefore, strictly periodic. After spawning the ovary resembles an empty sack, and the new batch of eggs only starts development after the fish has spawned.

Spawning, therefore, is also strictly periodic and the time between two

spawning periods is equal to the time, which the egg wants to separate from the egg-stock, grow and mature. Of the absolute duration of this period, this part of the investigation tells us nothing.

2. Caesio erythrogaster (K. v. H.) C. V. E k o r k u n i n g.

18 Specimens of this species were investigated. The material gives a fairly complete life-history of the maturation of the eggs.

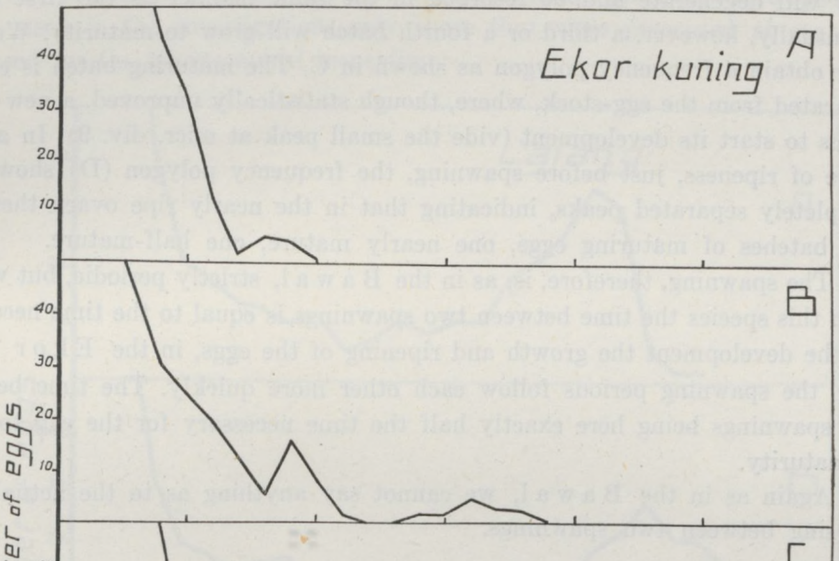


Fig. 4. — Frequency polygons of the diameters of the eggs in the ovary of 4 specimens of E k o r k u n i n g, *Caesio erythrogaster* (K. v. H.) C. V.

A (figure 4) shows the frequency polygon of the ova of a very young specimen. A small batch of eggs has separated from the general egg-stock.

This first batch of eggs, however, does not grow to maturity. As soon as the ova have reached a size of about 17 micr. div. they begin to degenerate and are ultimately resorbed. The polygon then shows the shape as in B. The batch of maturing eggs is small and there are at least as many eggs that are degenerating. We see further, that a new batch of eggs has already separated from the egg-stock. This batch of eggs is larger than the first as shown in A. But it remains uncertain whether the eggs will reach maturity. It may be that they will degenerate and be resorbed in the same manner as the first batch. Eventually, however, a third or a fourth batch will grow to maturity. We then may obtain a frequency polygon as shown in C. The maturing batch is clearly separated from the egg-stock, where, though statistically unproved, a new batch seems to start its development (vide the small peak at micr. div. 9). In a later stage of ripeness, just before spawning, the frequency polygon (D) shows two completely separated peaks, indicating that in the nearly ripe ovary there are two batches of maturing eggs, one nearly mature, one half-mature.

The spawning, therefore, is, as in the Bawal, strictly periodic, but whereas in this species the time between two spawnings is equal to the time necessary for the development the growth and ripening of the eggs, in the Ekor kuning the spawning periods follow each other more quickly. The time between two spawnings being here exactly half the time necessary for the egg to grow to maturity.

Again as in the Bawal, we cannot say anything as to the actual time elapsing between two spawnings.

3. **Clupea fimbriata** (C.V.). Tembang.

Although the ovaries of many species were preserved, only the one that had been fixed at sea immediately after it had been caught, yielded good results.

The material, therefore, is very scanty, but luckily the ovary of this specimen was well advanced to maturity so that the frequency polygon of the ova gave a fairly good idea of the periodicity of the spawning. Nevertheless, we must not forget, that our conclusions are based on one specimen only.

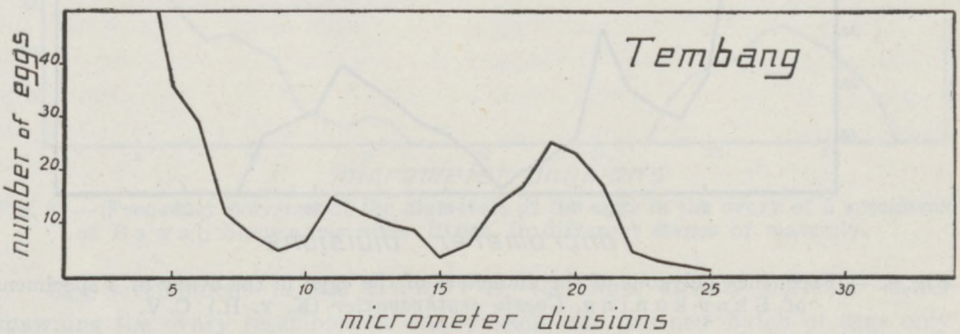


Fig. 5. — Frequency polygon of the diameters of the eggs in the nearly ripe ovary of *Tembang*, *Clupea fimbriata* (C.V.)

Figure 5 shows this frequency polygon. As in Ekor kuning we find two clearly separated batches of developing eggs, so that we may conclude that the periodicity of the spawning of this species will resemble that of the Ekor kuning, with this restriction however, that the time between two spawnings may be very different in the different species.

4. Decapterus russelli (Rüpp.). Lajang.

The ovaries of 10 specimens were available. Although many more specimens were used in the investigation, only those that were preserved at sea could be used for the microscopical inspection.

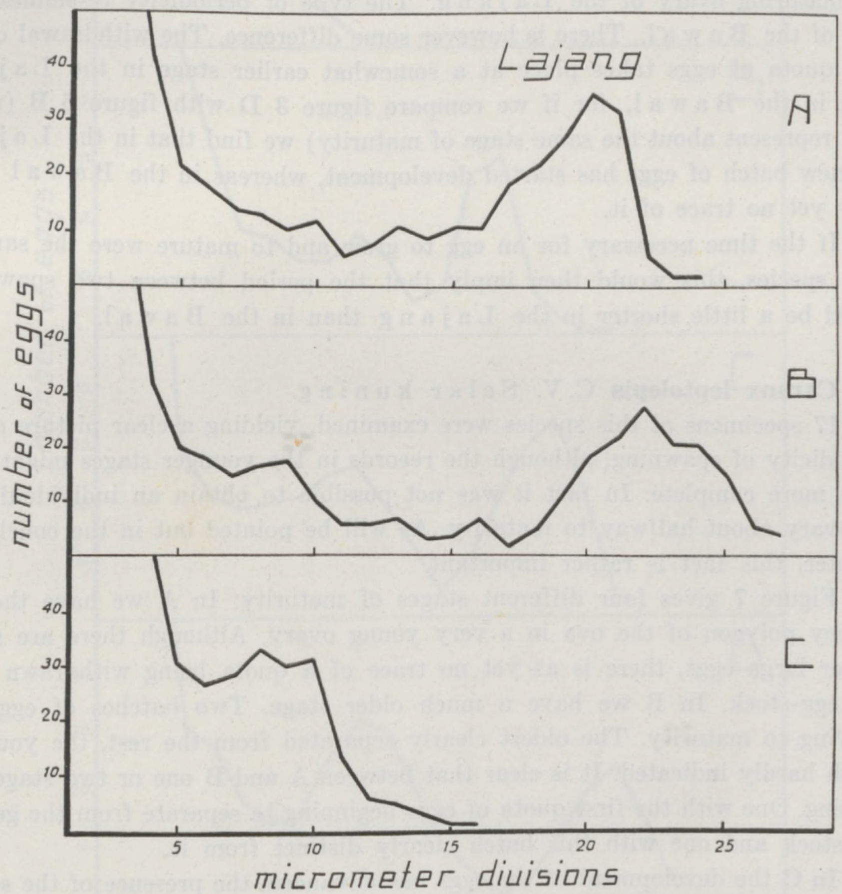


Fig. 6. — Frequency polygons of the diameters of the eggs in the ovary of three Specimens of Lajang, *Decapterus russelli* (Rüpp.).

Figure 6 gives a good idea of the egg-development in this species. In A we have the frequency polygon of the ova in an ovary well advanced to maturity. There is only one batch of developing eggs and this graph resembles in in many respects the one given for the Bawal in figure 3 D.

The ovary, the frequency curve of which is given in B, is very near to maturity. There is not much difference with the preceeding graph, but besides of the fact that the eggs of the maturing batch are larger, we find a low peak at micr. div. 9. Although statistically not yet reliable, we may safely conclude that this is the beginning of the development of a new batch of eggs, if we compare this graph with the following. This is the frequency curve of the ova after spawning. A new batch has separated from the general egg-stock from which it is clearly distinct. This is the end of the foregoing and the beginning of a new cycle.

These graphs show that only one batch of developing eggs is present in the maturing ovary of the L a j a n g. The type of periodicity resembles thus that of the B a w a l. There is however some difference. The withdrawal of the new quota of eggs takes place at a somewhat earlier stage in the L a j a n g than in the B a w a l, for if we compare figure 3 D with figure 6 B (which both represent about the same stage of maturity) we find that in the L a j a n g the new batch of eggs has started development, whereas in the B a w a l there is as yet no trace of it.

If the time necessary for an egg to grow and to mature were the same in both species, this would then imply that the period between two spawnings would be a little shorter in the L a j a n g than in the B a w a l.

5. Caranx leptolepis C.V. S e l a r k u n i n g.

17 specimens of this species were examined, yielding a clear picture of the periodicity of spawning, although the records in the younger stages might have been more complete. In fact it was not possible to obtain an individual with an ovary about halfway to maturity. As will be pointed out in the concluding chapter, this fact is rather important.

Figure 7 gives four different stages of maturity. In A we have the frequency polygon of the ova in a very young ovary. Although there are a few rather large eggs, there is as yet no trace of a quota being withdrawn from the egg-stock. In B we have a much older stage. Two batches of eggs are growing to maturity. The oldest clearly separated from the rest, the youngest batch hardly indicated. It is clear that between A and B one or two stages are missing. One with the first quota of eggs beginning to separate from the general egg-stock and one with this batch clearly distinct from it.

In C the development of the eggs has advanced, the presence of the second batch is more obvious and in D the two batches are distinct. This ovary is nearly ripe.

With restrictions to the time factor, this species shows thus in its individuals the same spawning periodicity as the E k o r k u n i n g.

6. Caranx mate C.V. S e l a r t j o m o.

7. Caranx malam (BL.) S e l a r m a l a m.

8. **Caranx crumenophthalmus** Blkr. Selar bentong.

The investigation of these three species includes 5 specimens each of Selar tjomo and Selar malam and 8 specimens of Selar bentong. In

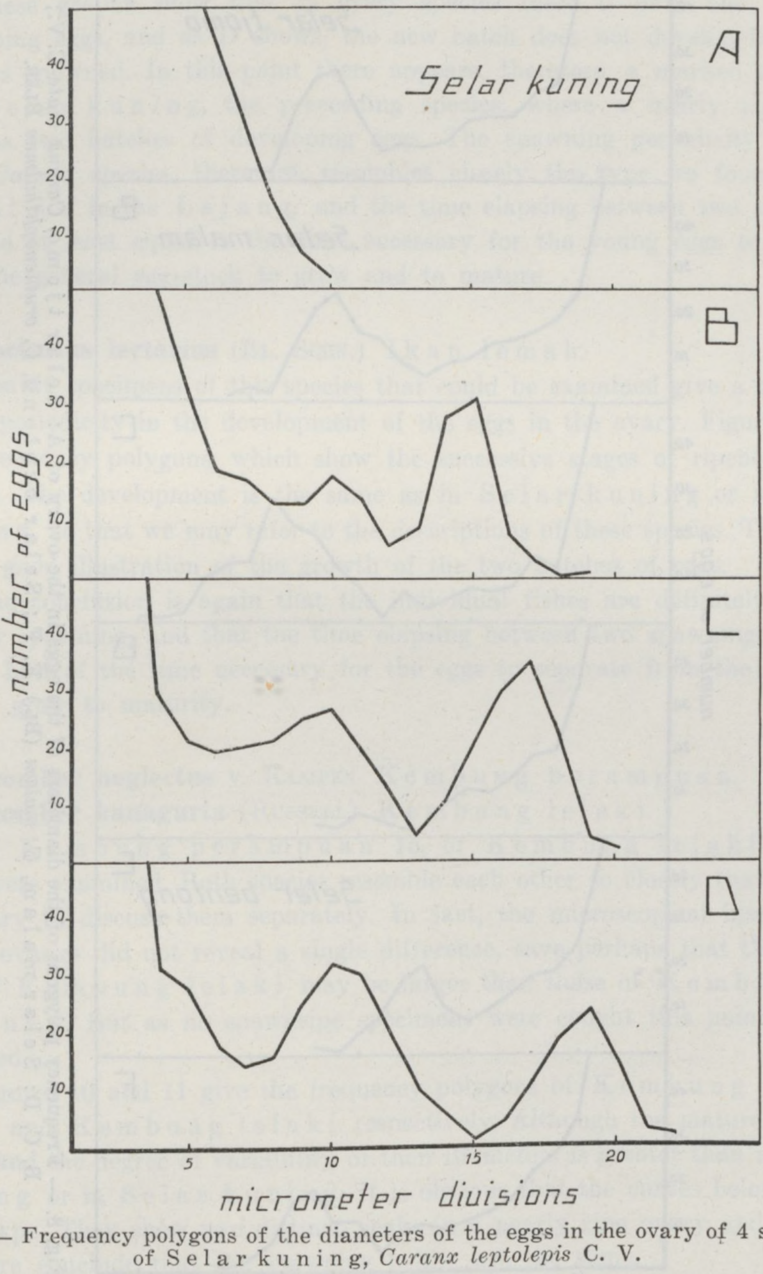


Fig. 7. — Frequency polygons of the diameters of the eggs in the ovary of 4 specimens of Selar kuning, *Caranx leptolepis* C. V.

the development of the eggs in the ovary these species resemble each other so much, that we will discuss them as one species.

Figure 8 shows some frequency polygons of these species. A and B, belonging to S e l a r t j o m o and S e l a r m a l a m respectively are more or less

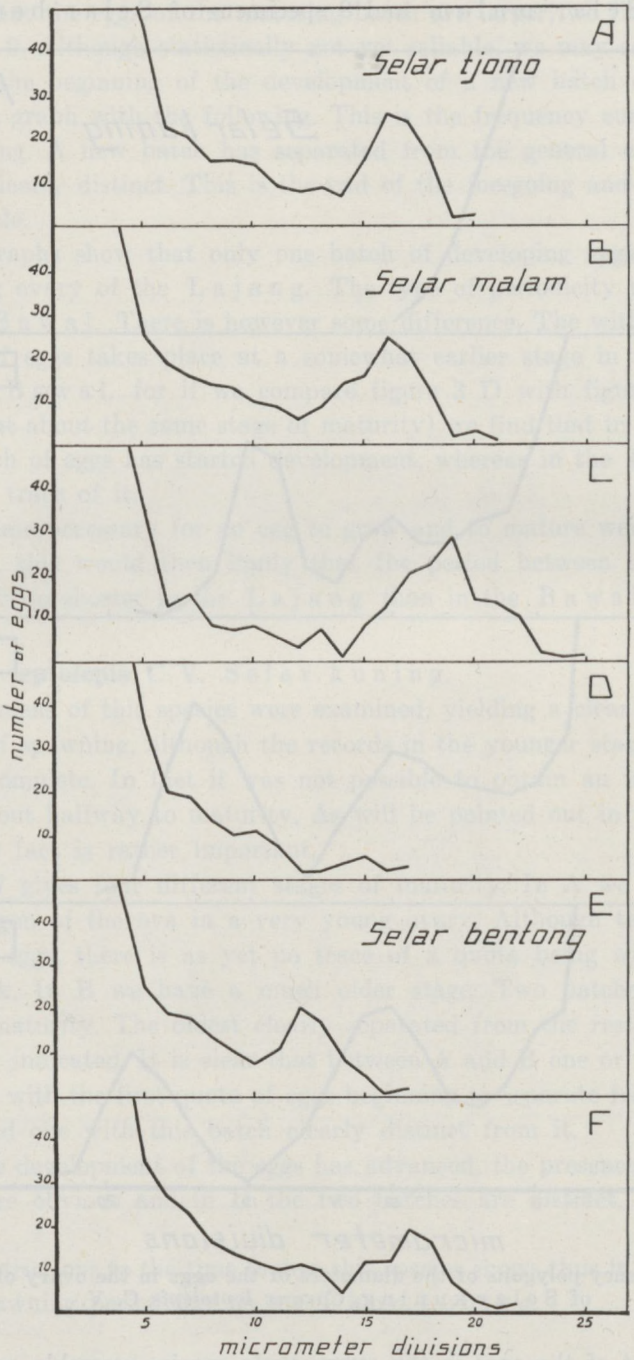


Fig. 8. — Frequency polygons of the diameters of the eggs in the ovary of A: S e l a r t j o m o, *Caranx mate* C. V.; B, C, D: S e l a r m a l a m, *C. malam* (BL.) E. F.; S e l a r b e n t o n g, *C. crumenophthalmus* BLKR.

in the same stage of maturity. There is no real difference between the two graphs. B, C, and D give successive stages of maturity in S e l a r m a l a m.

C is well advanced to maturity, D has just spawned. E and F give two different stages in Selar bentong. The curves show the same features as those of Selar malam and Selar tjomo.

These graphs show that in every species there is only one batch of developing eggs, and as D shows, the new batch does not develop before the fish has spawned. In this point there appears, therefore, a marked difference with Selar kuning, the preceeding species, where a nearly ripe ovary contains two batches of developing eggs. The spawning periodicity of these three *Caranx* species, therefore, resembles closely the type we found in the Bawal and in the Lajang, and the time elapsing between two spawnings must be at least equal to the time necessary for the young eggs to separate from the general egg-stock to grow and to mature.

9. Lactarius lactarius (BL. SCHN.) Ikan lemah.

The 24 specimens of this species that could be examined give a good idea of the periodicity in the development of the eggs in the ovary. Figure 9 gives four frequency polygons, which show the successive stages of ripeness of the ovaries. The development is the same as in Selar kuning or in Ekor kuning, so that we may refer to the descriptions of these species. The graphs give a good illustration of the growth of the two batches of eggs.

The conclusion is again that the individual fishes are definitely periodic in their spawning, and that the time elapsing between two spawnings is equal to one half of the time necessary for the eggs to separate from the egg-stock and to grow to maturity.

10. Scomber neglectus V. KAMPEN Kembung perampuan.

11. Scomber kanagurta (RUSSELL) Kembung lelaki.

Of Kembung perampuan 15, of Kembung lelaki 6 specimens were examined. Both species resemble each other so closely that it is not necessary to discuss them separately. In fact, the microscopical investigation of the ovaries did not reveal a single difference, save perhaps that the mature eggs of Kembung lelaki may be larger than those of Kembung perampuan. But as no spawnripe specimens were caught this point remains unsettled.

Figures 10 and 11 give the frequency polygons of Kembung perampuan and Kembung lelaki respectively. Although the mature eggs are larger and the degree of variability of their diameters is greater than in Ekor kuning or in Selar kuning, it is obvious that the curves belong to the same type. They show two distinct peaks in a nearly ripe ovary and we may therefore conclude that the spawning habits are the same.

There are, however, two features which make a more lengthy discussion necessary. In the first place it turned out that the number of eggs in the second batch was always smaller than that in the first, especially in Kembung pe-

r a m p u a n, and secondly, there was, compared with other species, an excessive number of degenerating eggs.

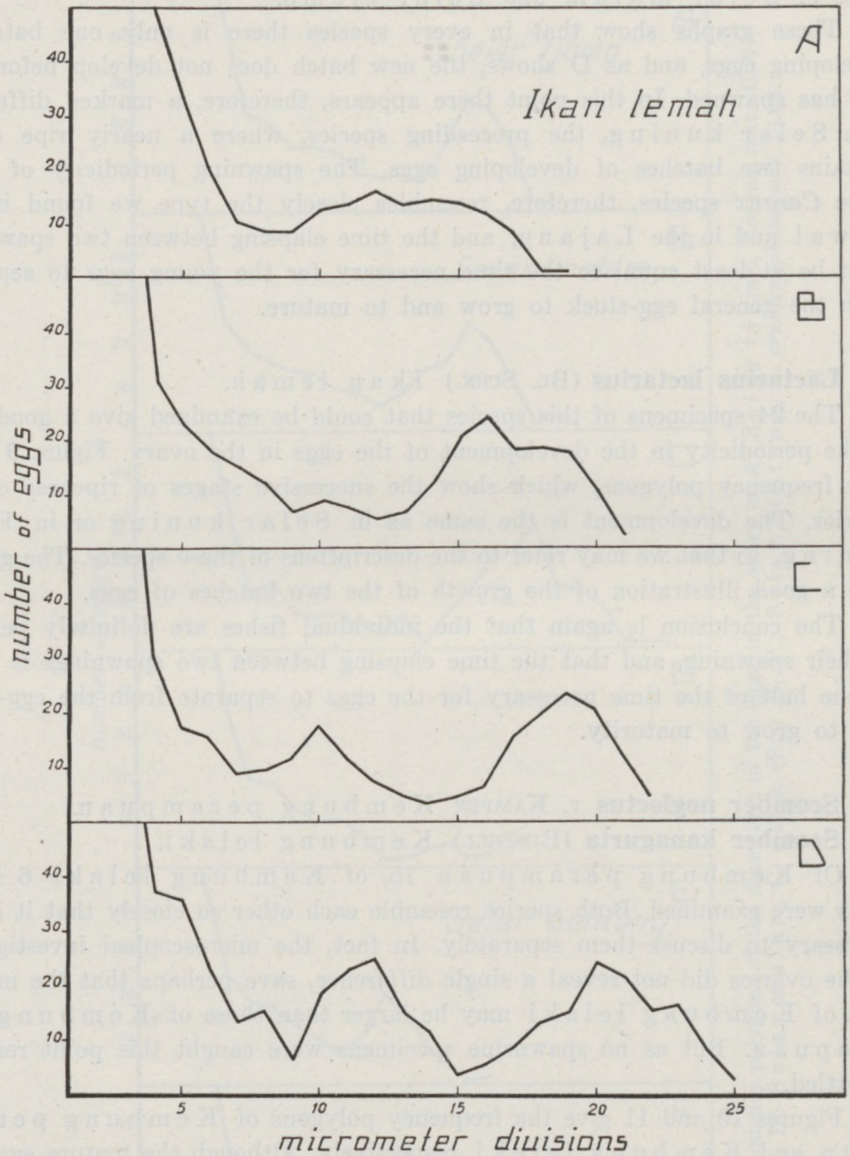


Fig. 9. — Frequency polygons of the diameters of the eggs in the ovary of four specimens of I k a n l e m a h, *Lactarius lactarius* (BL. SCHN.).

The differences in number of eggs between the first and the second batch are more distinct in K e m b u n g p e r a m p u a n than in K e m b u n g l e-l a k i. In the more extreme cases these eggs are so few in number that the frequency polygon resembles more or less that of the B a w a l or the L a j a n g. The question, therefore, arises if this species is realy comparable with E k o r

kuning or Selar kuning. We need not discuss this any further, because only continuous observations can reveal the fate of this second batch of eggs. As it is we have no certainty that they will ever reach maturity, be-

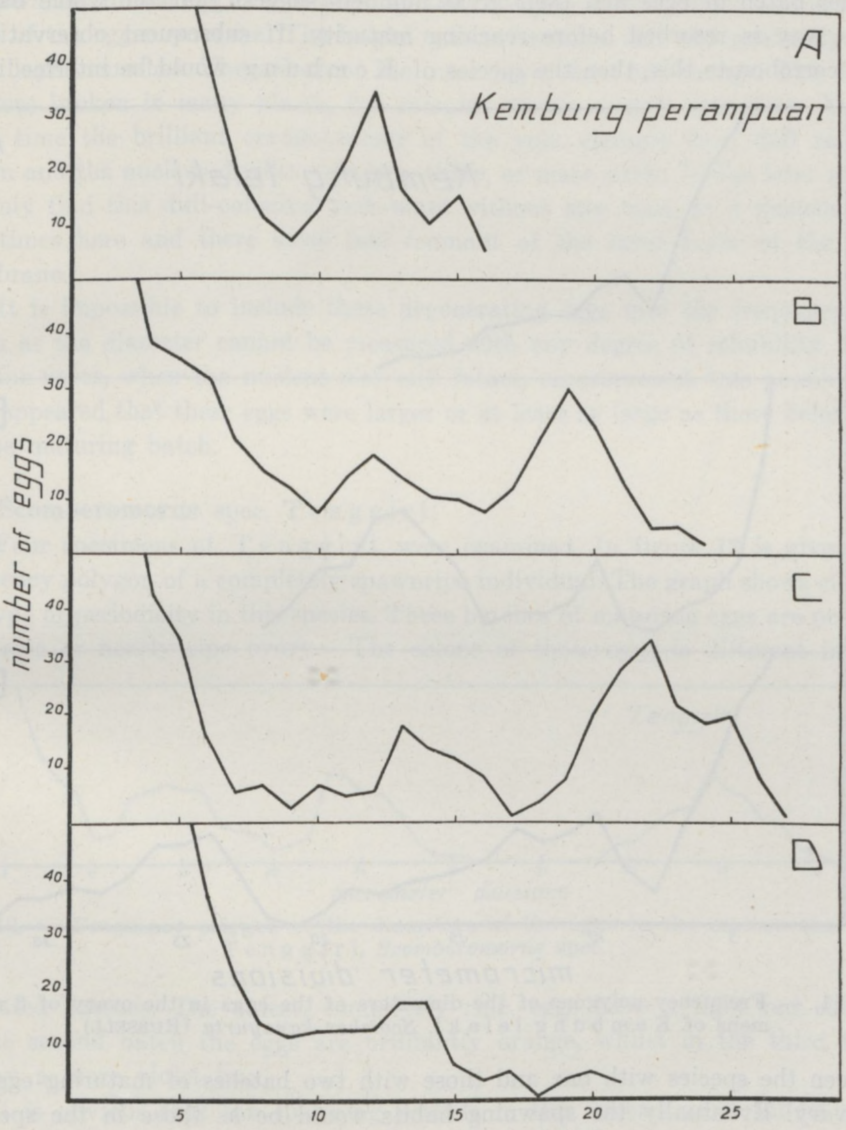


Fig. 10. — Frequency polygons of the diameters of the eggs in the ovary of four specimens of Kembung perampuan, *Scomber neclectus* van Kampen.

cause we have to count with the possibility that they are resorbed as soon as they have grown to about the size of 20 micr. divisions.

In nearly every ovary we find a large number of degenerating eggs. It is true that these can be found in the ovaries of many other species, but then

their number is never excessive. In both species of K e m b u n g we find them in great numbers, most abundant in the maturity stage which is represented by polygon B in figure 10. This points to the possibility that they belong to an older batch of eggs and their great numbers suggest that the whole batch in this way is resorbed before reaching maturity. If subsequent observations would corroborate this, then the species of K e m b u n g would be intermediate

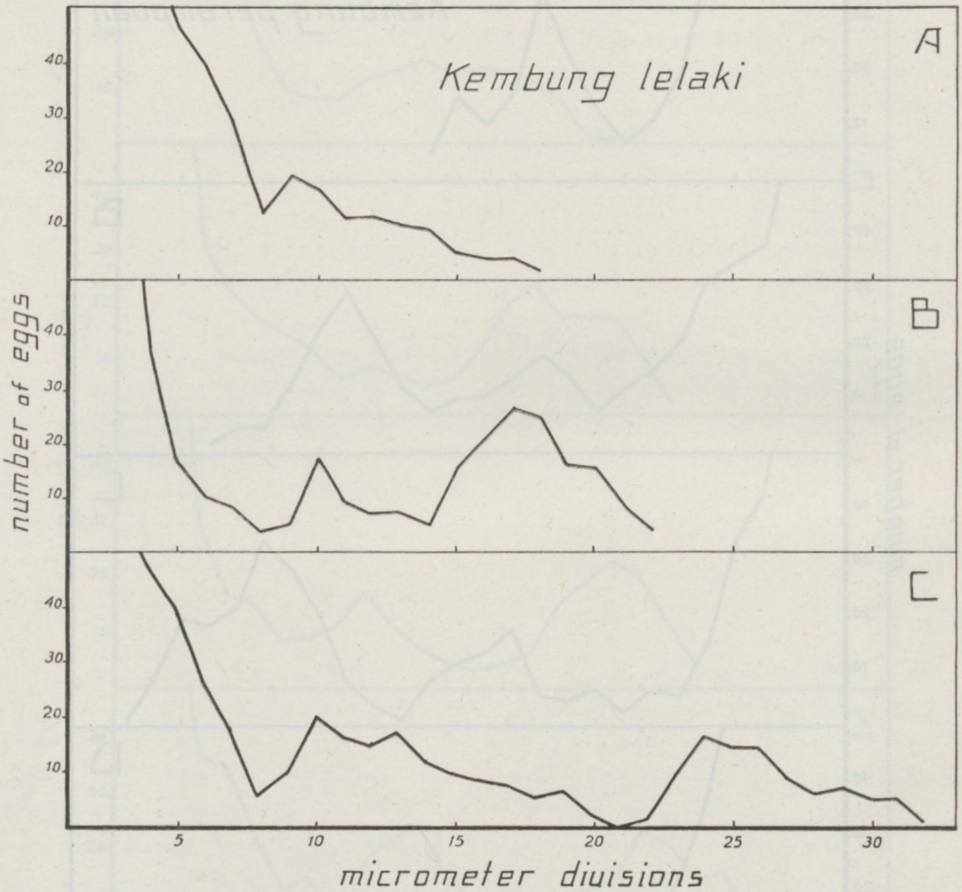


Fig. 11. — Frequency polygons of the diameters of the eggs in the ovary of 3 specimens of K e m b u n g l e l a k i, *Scomber kanagurta* (RUSSELL).

between the species with one and those with two batches of maturing eggs in the ovary. Eventually the spawning habits would be as those in the species which show only one peak in the frequency polygons of the ova of a mature ovary.

As degenerating eggs can be found in most of the species here studied, I will describe this process in some detail as it can be studied in the fixed and stained material.

In K e m b u n g the egg membrane consists of two distinct layers which in the fixed material become sometimes separated from each other. They stain

differently in the eosin. The outer layer takes a distict orange hue, whilst the inner one is more or less rose-coloured. In the stage just before resorption starts the yolk-mass is granular and of a rich orange colour. The beginning of the degeneration of the egg is indicated by the changing of the colour of the outer layer of the egg-membrane. The bright orange becomes dull and gradually this outer layer vanishes. The colour of the inner layer does not change. This layer becomes broken in many places, but remains visible a very long time. At the same time the brilliant orange colour of the yolk changes to a dull reddish brown and the nucleus divides into two, three, or more parts. In the later stages we only find this dull-coloured yolk-mass without any trace of a nucleus and sometimes here and there some last remnant of the inner layer of the egg-membrane.

It is impossible to include these degenerating eggs into the frequency polygon as the diameter cannot be measured with any degree of reliability. Only in some cases, when the nucleus was still intact, measurement was possible. It then appeared that these eggs were larger or at least as large as those belonging to the maturing batch.

12. Scomberomorus spec. T e n g g i r i.

Four specimens of T e n g g i r i were examined. In figure 12 is given the frequency polygon of a completely spawnripe individual. The graph shows clearly the type of periodicity in this species. Three batches of maturing eggs are present in a ripe or nearly ripe ovary. The colour of these eggs is different in the

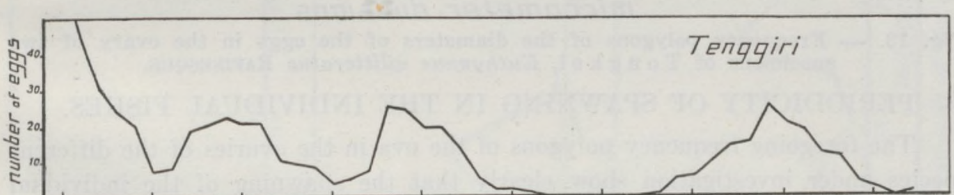


Fig. 12. — Frequency polygon of the diameters of the eggs in the mature ovary of T e n g g i r i, *Scomberomorus* spec.

separated batches. The oldest, completely ripe, eggs have a light red colour. In the second batch the eggs are brilliantly orange, whilst in the third they display a more violet hue.

It is obvious that the spawning periods in this species must follow each other more rapidly than in one of the preceding species.

13. Euthynnus allitteratus (RAFINESQUE) T o n g k o l.

Of this species three specimens were examined, which gave two stages of maturity. Figure 13 shows that the type of egg-development is the same as in E k o r k u n i n g or S e l a r k u n i n g. B is the frequency polygon of the ova of a nearly ripe ovary. Some of the eggs had already burst from the follicles.

The third specimen was in the same stage of maturity, the frequency curve is materially the same as in figure B. This ovary showed the curious phenomenon that a large number of the maturing eggs did not burst from their follicles, but were beginning to degenerate. These eggs showed the same stages of resorption as described for the K e m b u n g species.

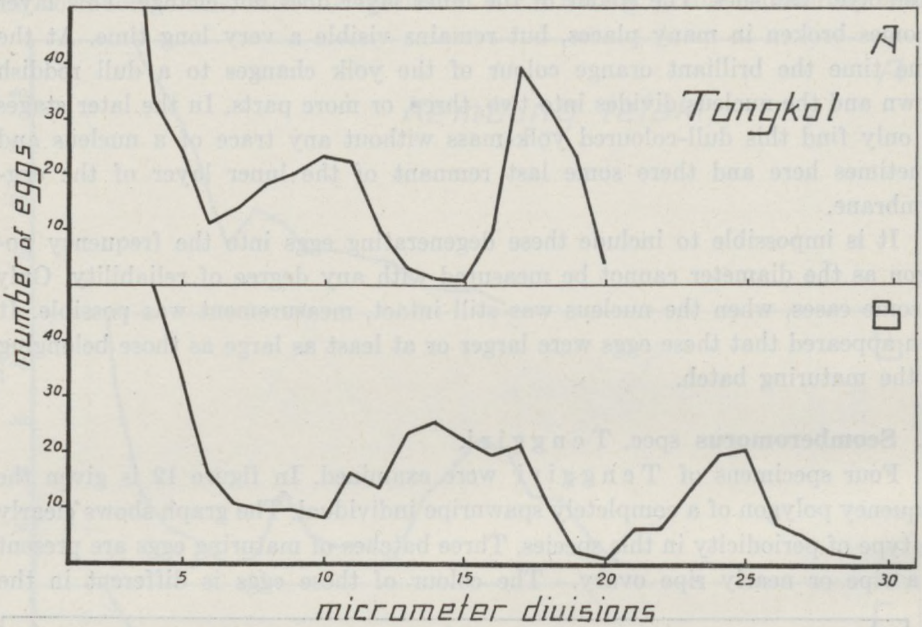


Fig. 13. — Frequency polygons of the diameters of the eggs in the ovary of two specimens of T o n g k o l, *Euthynnus allitteratus* RAFINESQUE.

PERIODICITY OF SPAWNING IN THE INDIVIDUAL FISHES.

The foregoing frequency polygons of the ova in the ovaries of the different species under investigation show clearly that the spawning of the individual fishes is strictly periodic. Constant and typical differences encountered enable us to distinguish three distinct types. These three types are shown in figure 14.

A gives the type that is represented by the B a w a l, the L a j a n g and the three species of S e l a r, S e l a r t j o m o, S e l a r m a l a m and S e l a r b e n t o n g. There is only one batch of maturing eggs and after spawning the ovary resembles an empty sack. The frequency curve of the ova is then as shown in figure 3 E. Only a comparatively small number of larger eggs is present and it is probable that these eggs will degenerate and be resorbed as soon as a new quota of eggs separates from the general stock.

B is the type we found by T e m b a n g, I k a n l e m a h, S e l a r k u n i n g, E k o r k u n i n g. Before the first quota of eggs has reached maturity a second batch of eggs separates from the general stock, so that just before spawning the frequency curve shows two well separated peaks. After spawning the ovary contains, beside the small eggs of the general egg-stock, a batch of rather large eggs, halfway to maturity, which will be spawned in due course.

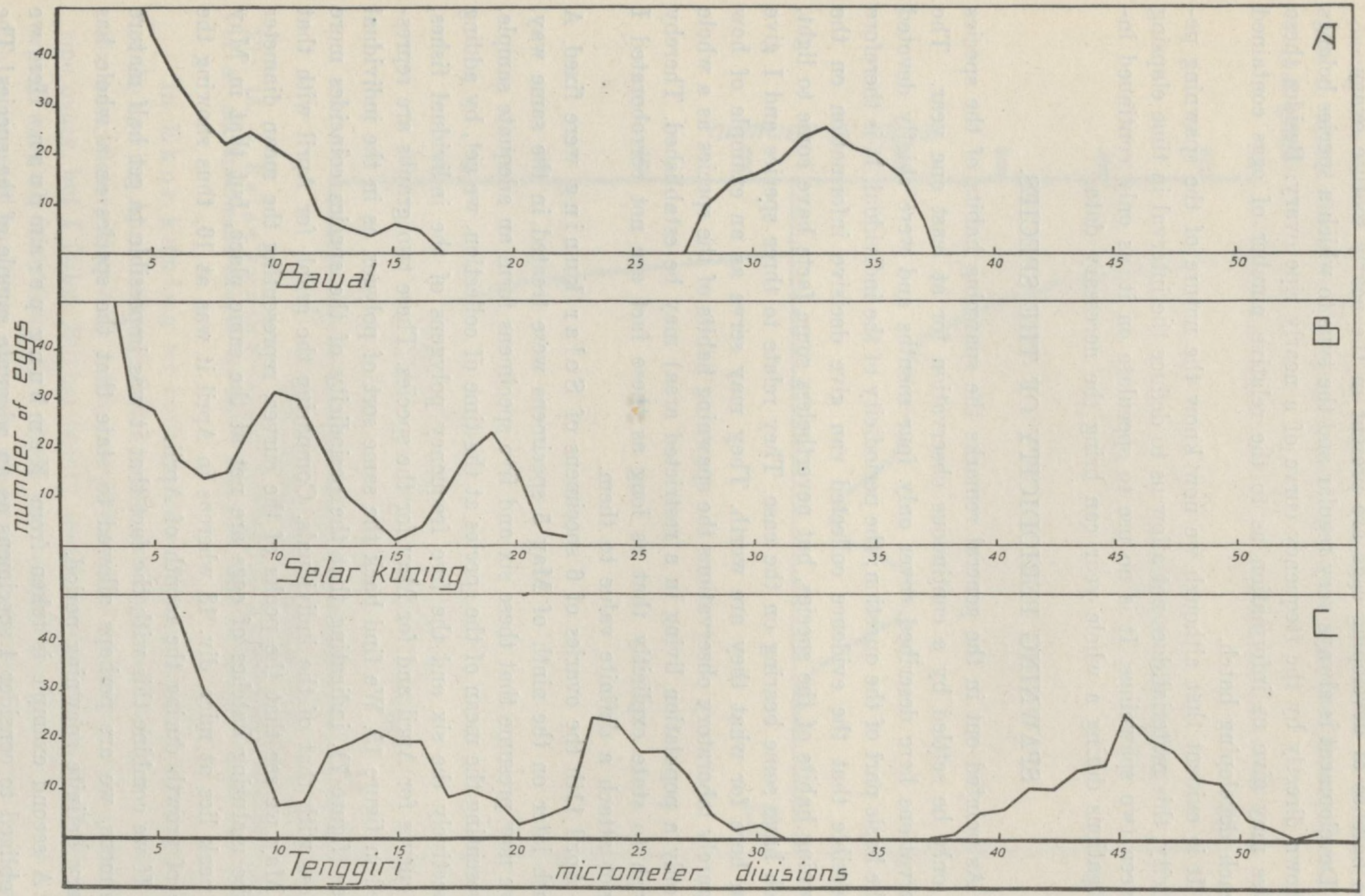


Fig. 14. — Frequency polygons of the diameters of the eggs in the ovary of mature or nearly mature specimens of B a w a l, *Stromateus niger* Bloch; S e l a r k u n i n g, *Caranx leptolepis* C. V. and T e n g g i r i, *Scomberomorus* spec., showing the three types of egg-development.

The third type C, is represented by the Tenggiri. Here not less than three batches of developing eggs are present in the nearly mature ovary.

Development is always very regular and the type to which a species belongs is shown directly by the frequency curve of a nearly ripe ovary. Besides these curves may give us information as to the relative number of eggs contained in each developing batch.

It is evident that although we now know the nature of the spawning periodicity, this material does not allow us to deduce the interval in time elapsing between two spawnings. It is no use to speculate on it, as only continued investigations during a whole year can bring the necessary data.

SPAWNING PERIODICITY OF THE SPECIES.

As pointed out in the general remarks the spawning habits of the species can only be settled by a continuous observation for at least one year. The observations here described cover only four months and were chiefly devoted to the basic part of the question; the periodicity of the individual. It is therefore impossible that the evidence collected can give decisive information on the spawning habits of the species, but nevertheless some facts have come to light, which have some bearing on the case. They relate to three species and I give them here for what they are worth. They may serve as an example of how by purely laboratory observations the spawning habits of the species as a whole (or only a population living in a restricted area) may be established. Thereby I wish to state explicitly that as long as these fact are not corroborated I cannot attach a definite value to them.

April 11th the ovaries of 6 specimens of Selar kuning were fixed. A month later on the ninth of May 5 specimens were treated in the same way. If we now presume that these six and five specimens form an adequate sample, representing the mean of the species at the time of collection, we get, by adding respectively the six and the five frequency polygons of the individual fishes, the curves for April and for May for the species. These two graphs are represented in figure 15. We find back the same sort of polygon as in the individual fishes (figure 7), indicating that the periodicity of the species coincides more or less with that of the individuals. Comparing the graph for April with that for May we see that the peaks of the curves, representing the mean diameter of the maturing batches of eggs are not at the same place, but that in May the peak lies at micr. div. 18 whereas in April it was at 16, thus showing the rate of growth during the month of April.

If we combine this with the fact that it was impossible to get half mature specimens, we are perhaps allowed to state that the species as a whole has a very definite spawning period.

A second example is taken from Kembung perampuan. Here we are obliged to consider 4 specimens as an adequate sample of the species! The graphs are given in figure 16. We see that in April the peak for the largest

eggs lies at 20, in May at 22, suggesting a growth of 2 micrometer divisions during the month of April. The second peak is much lower than the first, a fact to which attention has been drawn already in the description of the individual graphs.

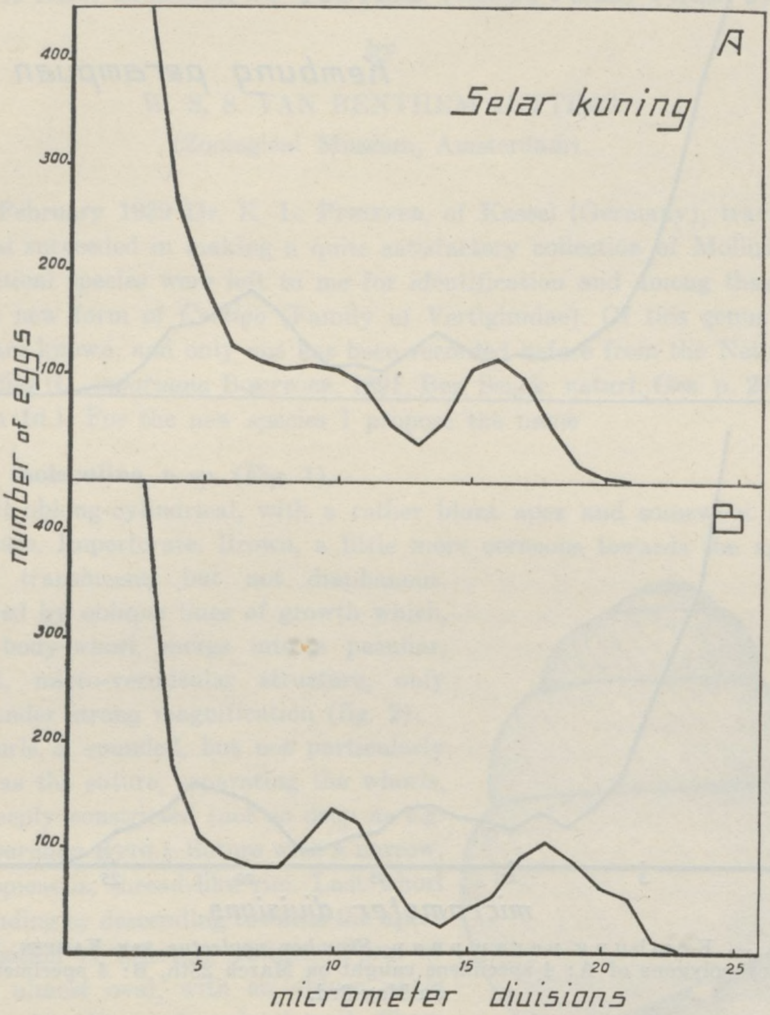


Fig. 15. — Selar kuning, *Caranx leptolepis* C. V. Combined frequency polygons of A: six specimens caught on April 11th; B: five specimens caught on May 9th.

In Ekor kuning we have evidence of another kind of the periodicity of the species. April 11th and 18th I found specimens well advanced to maturity. Six weeks later, May 30th I tried to obtain some specimens with a completely ripe ovary, but I failed. Buying twenty specimens at random I got 10 females which were all immature. Now there are indications, that Ekor kuning leaves its usual haunts to spawn in deeper water, because previous (not published) investigations showed that spawripe individuals are seldom or never found.

If spawning takes place in the months of May and June this would explain why only immature specimens were caught. But here again the total number of the specimens used does not allow us to regard this as an established fact [1]).

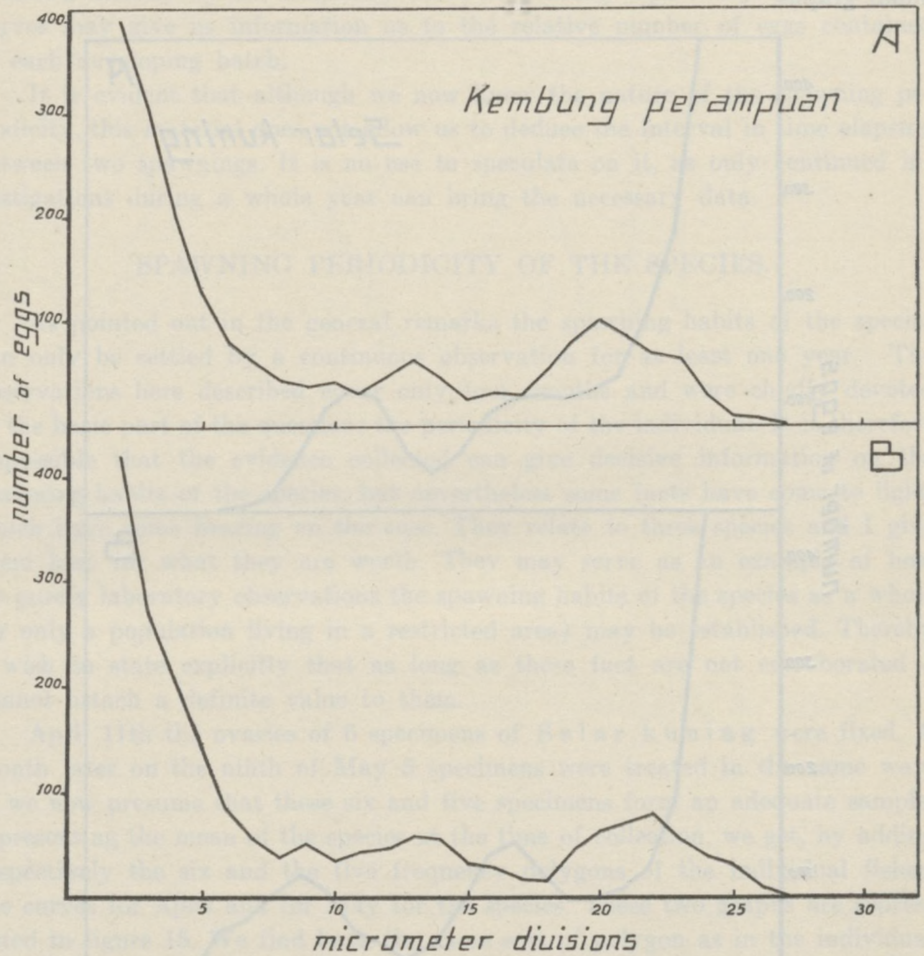


Fig. 16. — K e m b u n g p e r a m p u a n, *Scomber neglectus* VAN KAMPEN. Combined frequency polygons of A: 4 specimens caught on March 28th, B: 4 specimens caught on May 3rd.

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HICKLING, C. F. & RUTENBERG, E. 1936. The ovary as an indicator of the spawning period in fishes. Journ. Marine Biol. Ass. United Kingdom. N.S. 21, p. 311-318.

[1]) In the above we are assuming, that conditions are the same in different parts of the Java Sea. The three samples however were caught at different places.

ON A NEW SPECIES OF *COSTIGO* (Gastr., Pulm.) FROM JAVA

by

W. S. S. VAN BENTHEM JUTTING

(Zoological Museum, Amsterdam).

In February 1939 Dr. K. L. PFEIFFER, of Kassel (Germany), travelled in Java and succeeded in making a quite satisfactory collection of Molluscs. The more critical species were left to me for identification and among these I detected a new form of *Costigo* (Family of Vertiginidae). Of this genus only 5 species are known, and only one has been recorded before from the Netherlands East Indies (*C. saparuana* BOETTGER, 1891, Ber. Senck. naturf. Ges. p. 270, from Saparoea Id.). For the new species I propose the name

Costigo moleculina n. sp. (Fig. 1).

Shell oblong-cylindrical, with a rather blunt apex and somewhat broader to the base. Imperforate. Brown, a little more corneous towards the aperture. Shining, translucent, but not diaphanous. Sculptured by oblique lines of growth which, on the body-whorl, merge into a peculiar, wrinkled, micro-vermicular structure, only visible under strong magnification (fig. 2).

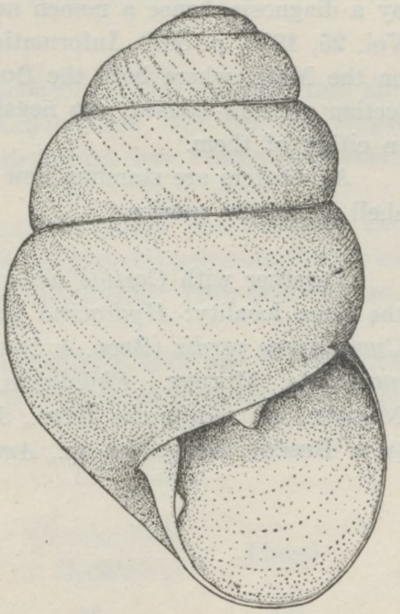


Fig. 1. — Shell of *Costigo moleculina* n.sp. About 38 times enlarged.

Whorls 5, rounded, but not particularly convex, as the suture, separating the whorls, is not deeply constricted (not so deep as e.g. in *C. saparuana* BTTG.). Suture with a narrow, but conspicuous, thread-like rim. Last whorl not ascending or descending towards the aperture. Position of aperture oblique. Form of aperture almost oval, with an obtuse angle between columellar and parietal wall. There are only two teeth, both very white and marked: a parietal one entering the aperture as a very short, compressed fold, and a columellar one, appearing only as a small white knob on the spindle, but not continuing interiorly.

Peristome simple, a little dilated on its entire outline, a little more so on the columellar side. Not continuous, the two margins being connected by a thin parietal callus.

Dimensions of the unique (holotypic) specimen: height 2.2 mm, breadth 1.4 mm, height of the aperture, from the point of attachment of the peristome on the penultimate whorl to the base, 1 mm.

Fig. 2. — Detail of sculpture of *Costigo moleculina* n.sp. About 100 times enlarged.

Habitat: Forest between the village of Tjisolok and the hot springs (Tjipanas) some miles inland, south coast of West Java, February 1939, collected by Dr. K. L. PFEIFFER.

Among the 5 species of *Costigo* known to exist, four are provided with palatal teeth (*C. saparuana* BTTGR., *borbonica* H. ADS., *desmazuresi* CROSSE and *nobrei* GIRARD). Therefore they are no immediate relations of our Java species where any trace of palatal teeth is missing. There is only one *Costigo* (*C. calamianica* (MLLDFF.) PILSBRY, from Busuanga, P.I.) which does not show them, and which, for this reason, has a closer affinity to the new form from Java. Unfortunately the d i a g n o s i s of *calamianica* by BOETTGER (Ber. Senck. naturf. Ges. 1891, p. 270, at the end of the discussion of *C. saparuana*), without giving it a name, is entirely insufficient and the n a m e proposed by MOELLENDORFF (Abh. naturf. Ges. Görlitz, Vol. 22, 1898, p. 152) is not accompanied by a diagnosis, hence a nomen nudum (compare also PILSBRY, Man. of Conch. Vol. 25, 1920, p. 367). Information at the Senckenberg Museum at Frankfort on the Main, where both the BOETTGER collection and the MOELLENDORFF collection are now housed, was negative as to the presence of this dubious species in either of them.

As matters are standing now it seems not hazardous to introduce the Java shell as a new species.

Together with *Costigo moleculina*, the following species were collected at the same locality: *Hydrocena javana* (MLLDFF.), *Leptopoma vitreum* (LESS.), *Cyclophorus perdix* (BROD. & SOW.), *Cyclotus discoideus* (SOW.), *Diplommatina auriculata* MLLDFF., *Philalanka diminuta* RENSCH, *Kaliella convexoconica* MLLDFF., *K. indifferens* BTTG., *Lamprocystis* sp. juv., *Hemiplecta bataviana* (V. D. BUSCH), *Durgellina* sp., *Amphidromus javanicus* (SOW.).

ORNITHOLOGISCHE NOTIZEN I-III.

Von

A. C. V. VAN BEMMEL

(Zoölogisch Museum, Buitenzorg).

I. Eine neue Domicella von der Insel Morotai.

Der Rassenkreis *Domicella garrula* umfasste bisher nur zwei Subspecies, nämlich *Domicella garrula garrula* (L.) von Halmahera und den Weda-Inseln und *Domicella garrula flavopalliata* (SALVAD.) von Morotai, Raoe, Batjan und Obi. Die Verbreitung dieser letztgenannten Subspecies war so unwahrscheinlich, dass Zweifel an ihrer Einheitlichkeit gerechtfertigt war. Durch Herrn G. A. L. DE HAAN im Jahre 1938 auf Morotai gesammeltes Material bestärkte die Vermutung, dass die Vögel von Morotai von der Subspecies *flavopalliata* verschieden sein könnten. Es liess sich in der Tat für Morotai eine neue Subspecies aufstellen, von der ich die Beschreibung hier folgen lasse:

Domicella garrula morotaiana nov. subspec.

Type: ♂. Wajaboela, Morotai, 10.III.1938 leg. G. A. L. DE HAAN. Cat. Mus. Buitenzorg 13247.

Habitat: Morotai, vielleicht auch Raoe.

Diagnose: Völlig übereinstimmend mit *Domicella garrula garrula,* aber mit einem deutlich abgezeichneten gelben Interskapularfleck, der bei der Rasse *garrula* entweder fehlt oder nur undeutlich angedeutet ist. Iris: orange. Schnabel: orange. Füsse: schwarz.

Bei der Subspecies *flavopalliata* (Terra typica: Batjan und Obi) mit der die Vögel von Morotai bisher vereinigt waren, ist der Interscapularfleck viel grösser und heller gelb, während die Flügeldeckfedern heller grün gefärbt sind, als bei den beiden anderen Rassen [1]).

Zum Vergleich gebe ich hier noch eine Uebersicht über die Maasse des Materials, das von dem Rassenkreis *Domicella garrula* im Zoologischen Museum in Buitenzorg vorhanden ist:

m o r o t a i a n a

Fundorte		Geschlecht	Culmen von d. Wachshaut	Flügel
Wajaboela	Morotai	♂ (Typus)	25	176
„	„	♂ (Cotypus)	24	169
„	„	sex inc. (Cotypus)	25,5	170

[1]) Schon FINSCH (Die Papageien II. 2. 1868 p. 778) hat auf die Unterschiede zwischen den Rassen hingewiesen, betrachtet diese aber als inkonstant.

garrula				
Weda Halmahera		♂	24,5	179
„	„	♂	23	162
Moke	„	♂	24,5	177
Weda	„	♀	24	169
Tilope	„	♀	24	162
Galela	„	sex. inc.	26	173
?	„	sex. inc.	22,5	163
flavopalliata				
Laiwoei Obi		♂	24	(154)
„	„	♂	23,5	167
„	„	♂	23	169
„	„	♀	24	173
„	„	♀	22	(156)
„	„	♀	22	161

II. Ergänzungen zur Faunenliste einiger Inseln im Niederländisch-Indischen Archipel.

Die Sammlung des Zoologischen Museums in Buitenzorg wurde in der letzten Zeit um einige Vögel von bisher nicht bekannten Fundorten bereichert, über die hier berichtet werden soll:

Billiton:

Eine vollständige Liste aller von dieser Insel bisher bekannten Vögel erschien in Treubia 16, p. 205 (CHASEN 1937). Zu dieser Liste kann man nunmehr hinzufügen:

Hydrophasianus chirurgus (SCOP.).

1 ♀, Gantoeng, Billiton, II.1939, leg. Ing. J. H. WESTERMANN.

P. Nangka (40 km. O. von Billiton):

Ducula rosacea rosacea (TEMM.).

1 ♀, P. Nangka 18.IV.1937 leg. F. J. KUIPER. Bis jetzt war diese Art noch nicht so weit westlich bekannt geworden.

Lombok:

Rostratula b. benghalensis (L.).

Sex. inc., Mataram, West-Lombok, 18.XII.1939, leg. E. G. A. LAPRÉ. In Niederländisch Indien bisher nur bekannt von Borneo, Sumatra, Java und Soembawa.

Morotai:

Ptilinopus hyogastra (TEMM.).

1 sex. inc., Wajaboela, Morotai, 13.III.1938, leg. G. A. L. DE HAAN. Bisher nur bekannt von Halmahera und Batjan.

III. Eine neue Subspecies von Ducula melanura Gray.

In Treubia VII, Suppl. 1930, p. 185 - 186 bespricht H. C. Siebers den Unterschied in der Zeichnung der äussersten Schwanzfedern bei *Ducula* (*Myristicivora*) *melanura* von Boeroe, Ceram und Obi einerseits und Vertretern der gleichen Art von Batjan und Halmahera andererseits. In seiner Beschreibung, der deutliche Abbildungen beigegeben sind, stellt er fest, dass bei den Vögeln von Boeroe, Ceram und Obi die weisse Zeichnung der Innenfahne auf die Aussenfahne übergreift, bei dem einzigen Exemplar von Halmahera, das ihm zur Verfügung stand, aber *nicht*. Hier ist also die Aussenfahne der äussersten Schwanzfedern völlig schwarz. Seine Schlussfolgerung lautet: „Sollte sich dieser Unterschied als konstant erweisen, was ich wohl annehmen möchte, dann müssten die Vögel der Süd-Molukken und Obi einen neuen Namen erhalten, weil *M. melanura* nach Exemplaren von Batjan und Gilolo (= Halmahera) beschrieben wurde."

Nun ist dieses Merkmal bei einer kleinen Serie, die durch Herrn G. A. L. de Haan im Jahre 1938 bei Weda (Halmahera) gesammelt wurde, in der Tat konstant, ausser bei einem einzigen nicht ausgewachsenem Exemplar, bei dem die weisse Zeichnung eben auf die Aussenfahne übergreift und die gesamte Zeichnung sehr vage umrissen ist. Dies muss hier aber als Jugendmerkmal angesehen werden (vgl. Siebers l.c. p. 184 und Hartert, Nov. Zool. 10. 1903 p. 60). Hierdurch ist also der endgültige Beweis für den subspezifischen Unterschied geliefert, und ich schlage daher vor, die Subspecies von den Süd-Molukken und Obi folgendermassen zu nennen:

Ducula melanura siebersi nov. subspec.

Type: (♀) En'botit, Boeroe, 3.III.1921, leg. Dr. L. J. Toxopeus. Mus. Buitenzorg No. 13566. Coll. No. 41.

Habitat: Boeroe, Ceram, Obi.

Diagnose: Unterscheidet sich im ausgefärbten Kleid von *Ducula melanura melanura* (G. R. Gray) durch das Uebergreifen der weissen Zeichnung von der Innenfahne der äussersten Schwanzfedern auf die Aussenfahne.

Eine Abbildung der Schwanzfeder des Typus findet sich in Treubia VII, Suppl. 1930 p. 185.

III. Eine neue Subspecies von Ducula melanura Gray.

In Treubia VII, Suppl. 1930, p. 185 - 186 bespricht H. C. Siebers den Unterschied in der Zeichnung der äussersten Schwanzfedern bei Ducula (Myristicivora) melanura von Boeroe, Ceram und Obi einerseits und Vertretern der gleichen Art von Batjan und Halmahera andererseits. In seiner Beschreibung, der deutliche Abbildungen beigegeben sind, stellt er fest, dass bei den Vögeln von Boeroe, Ceram und Obi die weisse Zeichnung der Innenfahne auf die Aussenfahne übergreift, bei dem einzigen Exemplar von Halmahera, das ihm zur Verfügung stand, aber nicht. Hier ist also die Aussenfahne der äussersten Schwanzfedern völlig schwarz. Seine Schlussfolgerung lautet: „Sollte sich dieser Unterschied als konstant erweisen, was ich wohl annehmen möchte, dann müssten die Vögel der Süd-Molukken und Obi einen neuen Namen erhalten, weil M. melanura nach Exemplaren von Batjan und Gilolo (= Halmahera) beschrieben wurde."

Nun ist dieses Merkmal bei einer kleinen Serie, die durch Herrn G. A. L. de Haan im Jahre 1938 bei Weda (Halmahera) gesammelt wurde, in der Tat konstant, ausser bei einem einzigen nicht ausgewachsenen Exemplar, bei dem die weisse Zeichnung eben auf die Aussenfahne übergreift und die gesamte Zeichnung sehr vage umrissen ist. Dies muss hier aber als Jugendmerkmal angesehen werden (vgl. Siebers l. c. p. 185 und Hartert, Nov. Zool. 10, 1903 p. 60). Hierdurch ist also der endgültige Beweis für den subspezifischen Unterschied geliefert, und ich schlage daher vor, die Subspecies von den Süd-Molukken und Obi folgendermassen zu nennen:

Ducula melanura siebersi nov. subspec.

Type: (♀) Ekoboeti, Boeroe, 3/III/1921, leg. Dr. L. J. Toxopeus. Mus. Buitenzorg No. 13566, Coll. No. 41.

Habitat: Boeroe, Ceram, Obi.

Diagnose: Unterscheidet sich im ausgefärbten Kleid von Ducula melanura melanura (G. R. Gray) durch das Uebergreifen der weissen Zeichnung von der Innenfahne der äussersten Schwanzfedern auf die Aussenfahne.

Eine Abbildung der Schwanzfeder des Typus findet sich in Treubia VII, Suppl. 1930 p. 185.

DESCRIPTIONS AND RECORDS OF SOUTH-EAST ASIATIC ODONATA (II)

by

M. A. LIEFTINCK

(Zoölogisch Museum, Buitenzorg).

The first part of this paper was issued in 1937 under the same title [1]). Material for the second part of it has been collected since 1932 chiefly by Mr. L. COOMANS DE RUITER in West Borneo, but of late years several fine collections have been made by other correspondents, especially by Mrs. M. E. WALSH, in West Sumatra and the lowlands of East Borneo.

Many more new Malaysian species than I can afford to describe at one time are available for study, but I fear that the reports on them must be spread out over a long period.

The material at my disposal of Malaysian *Amphicnemis* and *Oligoaeschna* has been fairly complete; and the descriptions have been drawn up and the synonymy worked out, in several cases, from the types of the species, so that it is hoped that comparatively few errors will have crept in.

SYSTEMATIC.

Fam. CALOPTERYGIDAE.	
Neurobasis chinensis longipes HAGEN, re-defined, key.	Borneo.
— — *chinensis* LINNÉ, key.	India to S. China and Sumatra.
— — *florida* HAGEN, key.	Java.
Fam. EUPHAEIDAE.	
Euphaea impar SELYS (incl. *inaequipar* SELYS), re-defined.	Malaya, Sumatra, Anambas I., Borneo.
— *subnodalis* LAIDLAW, notes.	Borneo.
Fam. LESTIDAE.	
Lestes praevius, sp. n.	Enggano I.; Borneo.
Fam. MEGAPODAGRIONIDAE.	
Podolestes buwaldai, sp. n.	Sumatra.
— *coomansi*, sp. n.	Sumatra.
— *orientalis* SELYS, notes.	(Borneo).

[1]) Treubia, 16, 1937, p. 55 - 119, figs.

Fam. PLATYSTICTIDAE.

Drepanosticta barbatula, sp. n. Borneo.

Fam. PLATYCNEMINIDAE.

Coeliccia arcuata, sp. n. Borneo.
— *coomansi,* sp. n. Borneo.
— *octogesima* SELYS, type discussed. Malaya.
— *palawana,* sp. n. Palawan.

Fam. AGRIONIDAE.

Ceriagrion hoogerwerfi, sp. n. Sumatra.
Amphicnemis, key to Malaysian species.
— *ecornuta* SELYS, re-defined, type discussed. Sumatra.
— *bicolor* (MARTIN), type discussed. Banguey I.
— *amabilis,* sp. n. Borneo.
— *annae,* sp. n. (= *wallacei* auct., nec SELYS). Borneo.
— *wallacei* SELYS (= *louisae* LAIDLAW), notes. Borneo.
— *gracilis* KRÜGER, re-defined, types re-described. Sumatra.
— *smedleyi* LAIDLAW, notes. Mentawei Ids.
— *billitonis,* sp. n. Billiton I.
— *mariae,* sp. n. Borneo.
— *martini* RIS, notes. Borneo.
— *madelenae* LAIDLAW, emend., allotype described. Borneo.

Fam. AESHNIDAE.

Oligoaeschna, notes on eastern species.
— *platyura,* sp. n., key. Borneo.
— *amata* (FÖRSTER), homotype redescribed. Borneo.
— *mutata,* sp. n., key. Borneo.
Amphiaeschna ampla basitincta, subsp. n. Sumatra.
Heliaeschna bartelsi, sp. n. (= *simplicia* auct., nec KARSCH). Sumatra, Borneo.
— *simplicia* (KARSCH) and *vanderweelei* MARTIN, notes.

Fam. CALOPTERYGIDAE.

Neurobasis chinensis longipes HAGEN (fig. 1 c).

Full literature:

1887. HAGEN, Abh. Zool.-bot. Ges. Wien, 37, p. 648. — ♂ Mindai, Borneo (*longipes*).
1869. SELYS, Bull. Acad. Belg. (2) 27, p. 648 - 649. — ♂♀ Sarawak, Borneo (*florida*).

1879. SELYS, Bull. Acad. Belg. (2) 47, p. 360 (pars: „exemplaires anormaux de Borneo") (*chinensis*).
1897. SELYS, Ann. Soc. ent. Belg. 41, p. 428 (pars: Sarawak; Labuan) (*chinensis florida*).
1897. FÖRSTER, Ann. Soc. ent. Belg. 41, p. 208 - 210. — ♀ Borneo (*chinensis* var.).
1911. RIS, Ann. Soc. ent. Belg. 55, p. 234. — ♂ Sintang, W. Borneo (*chinensis*).
1920. LAIDLAW, P.Z.S. London, p. 325. — Borneo (*chinensis*).
1930. HINCKS, Sar. Mus. Journ. 4, p. 51. — ♂ Sarawak (*chinensis*).
1931. LAIDLAW, J.F.M.S. Mus. 16, p. 241. — Borneo (*chinensis*).
1936. COOMANS, De Trop. Natuur, 25, p. 72 - 73, fig. 1 (♂♀). — W. Borneo (*chinensis*).

Material studied: — B o r n e o. Brussels Museum: large series of both sexes, "Labuan" [1]) (yellow label, SELYS's handwriting), *"Neurobasis chinensis* race *florida* Hag. Labuan" (SELYS, yellow). — Michigan Museum: 1 ♀ juv., "Labuan, Borneo" (id., ex coll. SELYS). — Leiden Museum: 7 ♂ (ad.), C.E. Borneo, Exped. A. W. NIEUWENHUIS, Mahakam river, Bloe-oe, IX.1894; 5 ♂, 2 ♀, id., Katoengan Mts., MAX MORET (indet.). — Buitenzorg Museum: 1 ♀, C.E. Borneo Exped. 1925, Koetai, H. C. SIEBERS, 12 ♂, 5 ♀; W. Borneo, environs of Singkawang, loc. diff. (riverine), II, VI, VII, VIII.1932, I.1933, I.1934, L. COOMANS DE RUITER.

In the "Monographie des Caloptérygines" (1854), SELYS and HAGEN have commented on the variability of the wings of the ♀. The following quotations may prove that the name *florida*, first proposed by HAGEN, applies to a ♀ from Java lacking a pseudo-pterostigma and with only a vestige of a white spot at the nodus; whereas in typical *chinensis*, the nodal spot is invariably quite distinct, the pseudo-pterostigma being nearly always present, at least so in the hind wing.

"N o u s avons hésité longtemps si nous ne séparerions pas, du moins comme race les exemplaires de J a v a de ceux du continent asiatique, mais aujourd'hui nous sommes portés à ne pas les décrire séparément" (p. 75); „Ce qui nous avait portés à croire à deux espèces, c'était l'aspect remarquable de la p r e m i è r e femelle que nous avions reçue de Java: elle n'a aucun vestige de ptérostigma aux quatres ailes et les secteurs ne sont pas même écartés à la place ou il se trouverait (chez la vraie *chinensis*, il manque parfois aux ailes supérieures). Les ailes sont presque incolores, mais cela peut tenir à l'âge de même que l'oblitération presque complète du point nodal blanc" (p. 76). "M. Hagen a examiné depuis un second exemplaire femelle, de Pulopenang......" (p. 76). „M. Hagen avait d'abord nommé cette variété ou race de Malaisie *Neurobasis florida*" (p. 76). — The spacings are mine.

[1]) Labuan, on the N.W.-coast of Borneo, *sec.* HAGEN, *op. cit.* 1887, p. 648. See also: H. M. PENDLEBURY & F. N. CHASEN, "A Zoological Expedition to Mt. Kinabalu, British North Borneo (1929)": — "The island of Labuan, classical ground to a naturalist, is now a very poor locality for collecting. The area of original jungle left is extremely small and limited to scanty patches on the tops of the hills and in the ravines. Many of the animals obtained there by early naturalists no longer exist on the island." (Journal F. M. S. Museums, 17, 1932, p. 8 footnote 8).

It is necessary to emphasize this point, as SELYS obviously misused the name *florida* when attributing it definitely, and first, to specimens from Sarawak, collected by WALLACE. These Bornean examples, as has been ascertained by HAGEN many years later, differ very markedly from true *florida*, and from typical *chinensis* as well.

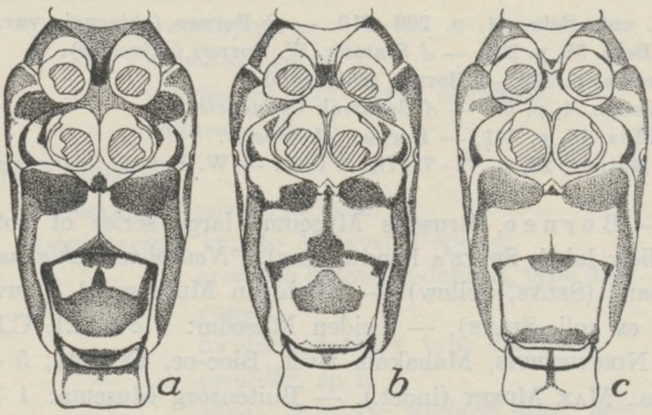


Fig. 1. Ventral aspect of meso-metathorax of *Neurobasis chinensis chinensis* (L.) (N. Sumatra, *a*); *N. chin. florida* HAG.-SELYS (W. Java, *b*); and of *N. chin. longipes* HAGEN (W. Borneo, *c*). Males.

HAGEN's description of *Neurobasis longipes* (*loc. cit.* 1887) goes well with our series of specimens from different parts of the island, and I content myself with referring all specimens before me to *longipes*. So far as my material goes, the differences found seem to clearly indicate subspecific kinship between *chinensis*, *florida*, and *longipes*.

The following key is based on a rich material of both sexes from various sources, including specimens of typical *chinensis* from Ceylon, Tonkin, Malaya, Sumatra and Nias.

Key to the Malaysian subspecies.

1. Venter of thorax conspicuously marked with black on the metepimeron and intersternum; median spot on intersternum large, brilliant metallic green (fig. 1 a-b). Legs very long but comparatively shorter and less slender than in *longipes;* anterior femora always less than 9 mm long; posterior femora < 9 - 9.5 mm, reaching back to the basal 2/9 of segm. 3. Posterior tibiae 1 mm shorter on an average than in *longipes*. Opaque area of hinder wing begins at base in *sc*, slightly distal to *arc* between $R + M$ and *Cu*, at the first crossvein in *cu*, and at base in the area posterior to *A;* a maximum of 3 rows of hyaline postero-marginal cells from about 1 - 2 mm beyond the wing-base to the end of the supplements between Cu_{2a} and Cu_2 (only one cell at the beginning and end of the area). ♀ At least with the nodus and subnodus of the hinder wing conspicuously creamy-white or -yellow in colour. 2

1'. Venter of thorax poorly and indistinctly marked with light or darker brown; a small, crescent-shaped and slightly metallic-green spot on the intersternum (fig. 1 c). Legs extremely long and slender, much thinner than in the preceding subspecies, anterior femora 8 - 8.5 mm long; posterior femora 10 - 10.5 mm, reaching back to the basal half of segm. 3. Posterior tibiae 1 mm

longer on an average than in the preceding subspecies. Bases of hinder wings more extensively hyaline; opaque area (maximum extent) begins at sc_8, at 4 - 6 cells distal to the origins of M_{1-2} in the space between $R + M_{1-2}$ and M_3, at the end of *q*, slightly proximal to *cu*, some distance proximad between the recurrent branch of Cu_{2a} and *A*. Area posterior to $Cu_{.a}$ hyaline. ♂ Apices of fore wings more pointed than in the preceding subspecies; hind wings comparatively broad but very gradually expanded, greatest width b e y o n d the middle of its length, apices more evenly rounded and hence tips more pronounced than in *chinensis* and *florida;* width and length of hw. 9.3 - 9.7: 29.5 - 30 (W. Borneo). ♀ Nodus and subnodus of all four wings slightly yellowish; no creamy spots. Pseudo-pterostigma absent from both pairs of wings. Distribution: Borneo. .... **longipes**

2. ♂ Wings broader; hinder pair more conspicuously expanded before the middle of their length, *e.g.* width and length of hw. 10 - 10.5: 31 - 32 mm, greatest width of hind wing at middle of its length. ♀ All four wings with an opaque creamy-yellow patch at nodus which usually covers the first cell distal to it. A large, creamy-white to citron-yellow pseudo-pterostigma in hinder wings, covering 7 - 10 cells, the nervures traversing it often incomplete and often missing in places; space between *C* and *R* holding the stigma distinctly expanded. Pseudo-pterostigma in fore wings small, covering 5 cells at a maximum, or entirely absent. Distribution: India and Ceylon, through Burma and Siam to S. China; Malaya, Sumatra, Nias. .... **chinensis**

2'. ♂ Wings narrower; hinder pair more evenly expanded before the middle of their length, thence narrow, with the distal third more parallel-sided and with the tips more rounded than in *chinensis* and *longipes, e.g.* width and length of hw. 9.2 - 9.5: 31 - 32 mm. Greatest width of hind wing at middle of its length. ♀ All four wings with the nodus and the subnodus creamy-yellow but with a vestige only of an opaque creamy-yellow spot immediately distal to it, filling up barely the basal fourth of the first cell distal to the nodus. No traces of a pseudo-pterostigma. Distribution: Java. .... **florida**

Fam. EUPHAEIDAE.

Euphaea impar SELYS.

1859. SELYS, Bull. Acad. Belg. (2) 7, p. 441 - 442 (*impar*), 442 (*inaequipar*). — ♂♀ Mt. Ophir, Malaya (*impar*), ♂ Sarawak (*inaequipar*).
1898. KRÜGER, Stett. Ent. Zeitg. 59, p. 78. — ♂ N.E. Sumatra.
1902. LAIDLAW, P.Z.S. London, p. 87. — ♂ Kelantan.
1920. LAIDLAW, Rec. Ind. Mus. 19, p. 27 (key, as subspecies) (*Pseudophaea*).
1920. LAIDLAW, P.Z.S. London, p. 327. — ♂ Sarawak (*Pseudophaea inaequipar* as subspecies).
1924. LAIDLAW, J. Mal. Br. Roy. As. Soc. 2, p. 298, 299. — ♂ Anambas I.
1930. HINCKS, Sar. Mus. Journ. 4, p. 51. — ♂ Sarawak (*inaequipar*, as subspecies).
1930. RIS, Mitt. Münch. Ent. Ges. 20, p. 85 (key), 85 - 86 (♂ Mt. Ophir, ♂ Sarawak, descr.) (*impar* + *inaequipar*).
1933. LAIDLAW, Bull. Raffles Mus. 18, p. 78. — ♂ Sarawak (*inaequipar*).

1935. LIEFTINCK, Misc. Zool. Sum. 92 - 93, p. 3. — ♂ S. Sumatra, notes (as subspecies).
1936. KIMMINS, J.F.M.S. Mus. 18, p. 78 — ♂ Sarawak (*inaequipar*).
1936. COOMANS, De Trop. Natuur 25, p. 73 - 74, fig. 2 (♂♀ phot.). — ♂♀ W. Borneo (*impar inaequipar*).

Material studied: — B o r n e o. Leiden Museum: 1 ♂ Br. N. Borneo, Mt. Marapok, Dent Province, coll. G., *"Euphaea impar"* (MARTIN det.); 2 ♂, C.E. Borneo, Exped. A. W. NIEUWENHUIS, Katoengan Mts., 1894, MAX MORET. — Buitenzorg Museum: 16 ♂, 4 ♀, E. Borneo, Koetai, Sangkoelirang distr., V-VI. 1937, M. E. WALSH; 1 ♂, C. E. Borneo Exped. Koetai, 22.VIII.1925, H. C. SIEBERS; 11 ♂, 2 ♀, W. Borneo, Singkawang, Mampawa, Bengkajang & G. Ambawang districts, III.1931, I, II, III, VII, IX, XII.1932, VI.1933, and II.1934, L. COOMANS DE RUITER.

In my 'Synopsis of the Odonata of Sumatra' (1935), I hesitated to believe that *E. impar* SELYS and *E. inaequipar* SELYS are different species, as was thought by RIS, who has been misled by the puzzling descriptions as given by SELYS.

Now that I have once more compared a number of examples from South Sumatra with our fine series of males from W. and E. Borneo, I am deliberately of opinion that the two 'species' cannot even be regarded as subspecies. From RIS's key, which is based on topotypical examples of both forms (one specimen each), it would appear that the opaque area of the hind wing of *inaequipar* is more extensive than it is in *impar*. This character does not hold good, for in our Bornean examples the extent of the opaque area varies from very slightly proximal to very slightly distal to the middle between *nod* and *pt,* while in my Sumatran specimens exactly the same variation is to be noted (1 proximal, 2 at middle, 1 distal).

As to the position and width of the blue mesepisternal band, I am unable to find any difference between the two forms; in both series the inner border of this band in dorsal view runs obliquely to the mid-dorsal carina; *c.q.* the black area enclosed by the two bands widens gradually from below upwards; and in only one of the Sumatran individuals the blue bands are somewhat more abruptly narrowed to above. In all specimens before me, these blue antehumeral bands on their ventral ends are definitely wider than the black spaces on both ends of the median carina: in some of the males from East Borneo even more distinctly so than in the Sumatran examples (*cf.* RIS's notes, where it is just the reverse). The mesinfraepisternites of all specimens examined are spotted with blue: one small juxta-humeral spot and one somewhat larger ventral (median or posterior) spot. I have failed to discover any differences in the width or shape of the irregular black stripe bordering the ventral margin of the blue patch covering the thoracic sides, nor have I found any variation in the genital organs and anal appendages. Lastly, the shape of the hind wings as well as the measurements of the body are practically alike in the two forms:

Borneo ♂ abd. + app. 29 - 33, hw. 23 - 25 mm.

Sumatra ♂ abd. + app. 31 - 31.5, hw. 24.5 - 25 mm.

Female. — The ♀ of *impar* is probably less rarely come across than that of *E. tricolor* and its allies.

The anterior parts of the head are bright greenish-yellow instead of blue, the labrum having occasionally a pale blue tint. Pale frontal spots band-like, broadly connected in the median line.

Dorsal thoracic fascia similar in principle to the male but dark reddish-brown instead of black. Sides dirty bluish- or olive-green with a diffuse brownish spot at the dorsal end of the humeral and second lateral sutures, and traces of brownish streaks near the lower margin of the mesepimeron, the metepimeron and round the spiracle. The dorsal margin of the pleurae is continuously bordered with dark brown. Venter of thorax pruinosed white.

Wings hyaline, or almost so; bases faintly yellowish.

Abdomen brownish-black. There are small but quite distinct dorso-lateral yellow spots placed transversely along the bases of segm. 3 - 7; these spots are almost fused posteriorly with a lateral system of pale marks, consisting merely of straight, longitudinal stripes, greenish-yellow in colour.

Length: abd. + app. 25 - 27, hw. 23.5 - 25 mm.

E. impar is decidedly a shade-loving insect, preferring brooks and small streams in the depth of the forest. Apparently widely distributed and not uncommon in such places, where the males may be found perched on twigs in sunlit-openings high overhead.

Euphaea subnodalis LAIDLAW (fig. 2).

1915. LAIDLAW, P.Z.S. London, p. 31 - 32. — ♂♀ Kinabalu (*Pseudophaea*).
1920. LAIDLAW, P.Z.S. London, p. 326, 327 (key ♂). — ♂ ? ♀ Kinabalu (*Pseudophaea*).
1924. LAIDLAW, J. MAL. Br. Roy. As. Soc. 2, p. 298 (key) (*Pseudophaea*).
1930. RIS, Mitt. Münch. Ent. Ges. 20, p. 88 (key), 89. — ♂ Kinabalu.
1934. SCHMIDT, Arch. Hydrob. Suppl. 13, p. 326, pl. 17 fig. 4 (wings ♂).

Material studied: — B o r n e o. Leiden Museum: 5 ♂, Br. North Borneo, Mt. Marapok, Dent Province, coll. G. — Michigan Museum: 2 ♂, "Kinabalu-gebirge, Nord Borneo, 1900, Rolle vdt.", "*Euphaea tricolor* SELYS Subrasse *montana* m. Type, 1100 m, ♂" (FÖRSTER det.). — Buitenzorg Museum: 1 ♂, Mt. Kinabalu, 16.IX.1913, J. C. MOULTON (ex coll. LAIDLAW).

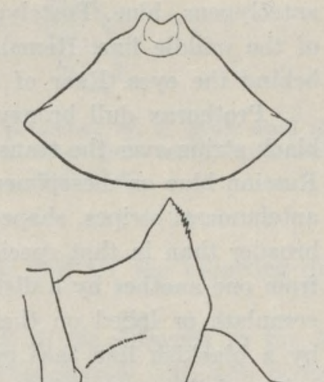


Fig. 2. Ventral aspect of seminal vesicle (top) and left side-view of anal appendages of *Euphaea subnodalis* LAID., from Mt. Marapok (bottom).

In addition to KIMMINS's [1]) notes on the genital characters of the males of *E. tricolor* SELYS, *sub-*

[1]) Cfr. D. E. KIMMINS, "The Odonata of the Oxford University Sarawak Expedition", Journal F. M. S. Museums, 18, 1936, p. 76 - 78, figs.

costalis SELYS and *laidlawi* KIMMINS, I wish to include a few remarks on the closely allied *E. subnodalis* LAIDLAW, based on material in the collection of the Michigan Museum, Ann Arbor, and in Dutch collections.

E. subnodalis takes rather an intermediate position between *subcostalis* and *laidlawi* in that the shape of the seminal vesicle on the second abdominal segment differs from both; its posterior margin is more convex than in *subcostalis* but less so than in *laidlawi*, whilst the lateral projections, though better pronounced than in *laidlawi*, are much less pointed than in *subcostalis* (fig. 2).

The hind wings of the ♂ of *subnodalis* are decidedly narrower than those of the two species just mentioned.

The anal appendages are very similar to those of *tricolor* SELYS; and, when looked at from aside, are almost of equal width from base to apex.

Fam. LESTIDAE.

Lestes praevius, sp. n. (fig. 3).

Material studied: — 1 ♂, 1 ♀ (ad.), E. Borneo, N. Koetai, Sangkoelirang distr., Maloewi, April 1937, M. E. WALSH leg. — 2 ♂, 1 ♀ (ad.), Enggano Id. (off the S.W.-coast of Sumatra), Boeah-boeah, May 30, 1936, J. K. DE JONG leg. Holotype ♂ and allotype ♀, Maloewi, E. Borneo, April 1937, in the Buitenzorg Museum.

Male (ad.). — Labium pale yellow. Mandible-bases, labrum, genae and anteclypeus, blue. Postclypeus black with two large blue spots on either side of the middle line. Remaining parts of the head bronzy-black; no pale spots behind the eyes. Rear of the head pruinose blue. Antennae brownish-black.

Prothorax dull bronzy-green above, sides blue, strongly pruinose; a thick black stripe over the transverse suture of propleuron. Synthorax, colours faded, Russian blue on mesepimeron. Dorsum marked by a pair of dull metallic-green antehumeral stripes, shaped similarly to those of *L. praecellens* and only little broader than in that species, straight on their inner border and well separated from one another by a distance scarcely narrower than their own width, deeply crenulate or lobed on their outer border. Each of these bands is surrounded by a blackish line that neatly follows the crenulations, the median interstice being of the same colour. Mesepimerites marked with two (or three) blackish dots; one on the upper end of the humeral suture and one, distinctly larger, shoulder-spot on the middle of the lower portion of the mesepimeron; this humeral spot is connected by a vague patch of brown to a blackish point along the lower end of the humeral suture.

Sides of the thorax with a black dot at lower end of the incomplete first suture and a slightly larger, triangular spot covering the spiracle. Two posterior black dots along lower margin of metepimeron. Venter of thorax pale-coloured, poststernum with two black points, one on each side of the median line. Sides and under surfaces rather coarsely powdered with light blue.

Coxae yellowish, striped with black posteriorly, heavily pruinose blue.

Femora dirty yellow with a thick black exterior stripe and a fine lateral line. Tibiae bright yellow, or greenish, exteriorly, black inside. Tarsi and spines black.

Wings hyaline, pterostigma deep black. Neuration as for genus, similar to typical *praemorsus* but the wings are definitely less abruptly petiolated and the nodal index is higher. Postnodals $\frac{14.14}{13.13}$ (type, Borneo), $\frac{14.14}{12.13}$, $\frac{15.16}{14.14}$ (paratypes, Enggano).

Abdomen marked similarly to *praemorsus;* dorsal marks dull bronzy-green, those on 2 - 7 after the slight sub-apical constriction a little more expanded, and with the basal blue annules a trifle larger than in that species. Segm. 8 - 10 black, each with an ochreous point on the middle of the sides. Abdomen with segm. 1 pruinose blue aside and underneath, otherwise not pruinose.

Superior anal appendages light yellow, extreme bases and exterior teeth sharply defined black. Inferior pair pale reddish-brown, yellow interiorly. Superiors forcipate, gently and regularly incurved, to meet at their apices, each with a strong sub-basal intero-dorsal tooth and with the interior sub-median projection armed with three strong unequal teeth. Inferiors broadly triangular in ventral view, divaricate, tapering, the tips rounded, not projecting beyond the level of the sub-basal tooth of the superior appendage, fringed apically with a bunch of golden yellow hairs (omitted in the left figure).

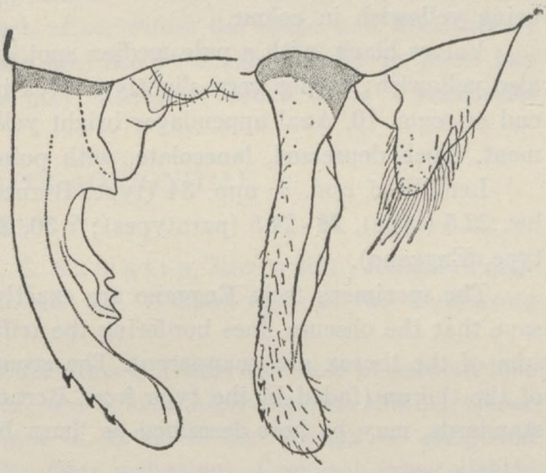


Fig. 3. *Lestes praevius*, sp. n. Male anal appendages, dorsal view (left side), and right side-view.

Female (ad.). — Generally similar to the male, but for the following differences.

The whole of the anterior surface of the head, as far upwards as the insertion-point of antennae, dirty yellowish-brown. Postclypeus with two diffuse brownish spots. Frons marked off laterally by a narrow bronze-green streak which is connected with the dark colour on the upperside of the head. Metallic-green colour on the vertex reduced: antennae and ocelli surrounded by large, confluent yellow rings, so that only the interspaces remain bronze-green. Epicranial lobes entirely dull bronze-green. Occipital area yellowish, sutures and a few points on either side, brown. Rear of the head black, slightly pruinose. Antennae dark brown, articulations between basal joints yellow.

Pro- and synthorax isabella-coloured, the former slightly pruinose white, laterally. Bronze-green spots on dorsum and sides of thorax distinct, similar in principle to those of the male, but considerably more reduced. Mesepisternal

bands narrow, the pale interstice equal in width to the bands themselves. Lateral brown spots distinct, arranged as in the opposite sex. Infraepisternites and lower portions of metepimera pruinose-white, as are the underparts of the thorax and the outer surfaces of all coxae.

Wings hyaline, pterostigma shaped as in male, dark brown in colour (type), or grey-brown (parallotype). Postnodals $\frac{14.14}{13.13}$ (type), $\frac{16.17}{15.16}$ (parallotype).

Abdomen robust, with cylindrical segments. Ground-colour pale olive-yellow, basal segments intermingled with green. Dorsal marks light bronzy brown with slight metallic lustre on basal segments; apical expansions very distinct. Terminal segments black, 8 and 9 each with an ochreous (or bluish) lateral spot, whilst 10 is brown with two small dorsal spots, most of the sides being yellowish in colour.

Valves black, with a pale median spot and with the serrulate lower margin also yellowish; border very slightly convex in lateral view; tips not surpassing end of segm. 10. Anal appendages bright yellow, a little longer than tenth segment, much depressed, lanceolate, with pointed tips.

Length: ♂ abd. + app. 34 (type, Borneo), 35.5 - 38 (paratypes, Enggano), hw. 22.5 (type), 24 - 24.5 (paratypes); ♀ 30, 23 (allotype, Borneo), 34, 28 (paratype, Enggano).

The specimens from Enggano are exactly identical with the Bornean type, save that the obscure lines bordering the trifid bronze-green marks on the dorsum of the thorax are unapparent. The ground-colour of the dorsum and sides of the thorax (faded in the type from Borneo), according to RIDGWAY's colour standards, may be best described as 'burn blue' in the other males.

This new species is the fourth representative of a small species-group, or 'Artenkreis', of which *L. praemorsus* SELYS, originally described from the Philippines, was the first to be reported. This last-mentioned species ranges from India to the Bismarck Archipelago; and although it will doubtless be possible to distinguish a number of local races for it, the separation of the many insular forms is by no means easy for each subspecies presents a considerable amount of colour variation [1]). It is my hope to deal with them in due time since I have now been able to study topotypes of this species.

The three other species are I think certainly very closely related to *L. praemorsus*, but two of them at least present some striking morphological peculiarities, or even colour-differences, which I suppose are constant and of specific value. These species all occur within the limits of the area of distribution of *praemorsus:*

L. pertinax LIEFT. (Nova Guinea, 15 Zool. 5, 1932, p. 493 - 495, fig. 1. — Terra typica: New Guinea.

L. praecellens LIEFT. (Treubia, 16, 1937, p. 59 - 62, fig. 2 - 3. — Terra typica: Java.

[1]) Cfr. SCHMIDT, Arch. Hydrobiol. Suppl. 13, 1934, p. 331 - 334, figs. 20 - 27.

L. praevius, sp. n. (*huj. op.*). — Terra typica Borneo; further distribution: Enggano Id. [1]).

L. praevius differs from *praemorsus* in the evenly curved shape of the superior anal appendages, which at the end of their second third are armed with a few robust interior teeth, absent in *praemorsus*. It further differs from typical examples (and from the indo-malaysian subspecies *decipiens* KIRBY as well) in its superior size, shorter and black pterostigma, in its less petiolated wings, and in details of colouring.

L. praevius is easily distinguished from *praecellens* by the presence of blackish dots on the metapleurae of the thorax.

Lastly, our new species differs from *pertinax* chiefly in the longer inferior appendages. In their outward appearance, colour-design and pruinescence, *praevius* and *pertinax* are very much alike, whilst the shape and armature of the superior appendages of the male are also strikingly similar in these two species. For these reasons *praevius* may ultimately prove to be a subspecies of the Papuan *pertinax*.

Fam. MEGAPODAGRIONIDAE.

Podolestes buwaldai, sp. n. (fig. 4 b).

Material studied: — 1 ♂ (ad.), E. Sumatra, Riouw Res., Rengat, Pangkalankasai, April 2, 1939, P. BUWALDA leg. Holotype in the Buitenzorg Museum.

Male (ad.). — Head almost entirely black. Hinge and base of median lobe of labium brown, darker towards apex, lateral lobes black; labrum shining. Genae and frons, between the insertion-point of antennae and margin of compound eyes, smooth and with slight metallic-blue reflections. Occipital ridge slightly bluish pruinose. Antennae black.

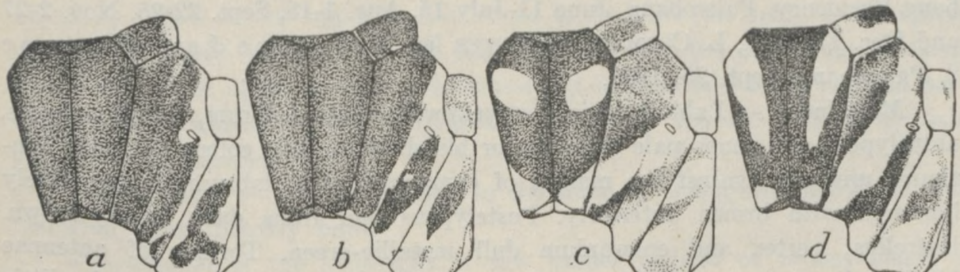


Fig. 4. Colour-pattern of synthorax of *Podolestes chrysopus* SELYS ♂ (W. Borneo, *a*); *P. buwaldai*, sp. n. ♂ (E. Sumatra, *b*); *P. coomansi*, sp. n. ♂ (E. Sumatra, *c*); *P. orientalis* SELYS ♀ (E. Borneo, *d*).

Prothorax black, thinly pruinose blue; suture between median lobe and epimeron marked off by an irregular yellow line. A yellow basal point on either side of the anterior lobe and a transverse streak of the same colour on each side along base of posterior lobe.

[1]) This record was erroneously given for *praemorsus* in my latest account of this species (*loc. cit.* p. 63).

Thorax black above as far down as the first lateral suture, mesepisterna and mesepimera with metallic-green lustre. Metapleurae dull ochreous, with two sharply defined, oblique, metallic-green bands, shaped as in fig. 3 b.

Venter auburn, paler among the sutures.

Coxae and trochanters auburn, paler behind. Outer surface of all femora Sandford's brown, apices darkened, chestnut-coloured; inner surfaces bright orange-chrome. Tibiae salmon-orange exteriorly, inner surfaces orange-chrome. Tarsi orange-rufous, apical joint darkened towards tip; claws brown. Spines orange-rufous.

Wings identical in shape, and neuration also similar, to those of typical *chrysopus*. Pterostigma black. Nodal index $\frac{14.15}{14.14}$.

Abdomen coloured similarly to *chrysopus*, and anal appendages exactly identical in shape with those of that species. (See my description and drawings of *P. chrysopus* SELYS, from W. Borneo, in Treubia, 15, 1935, p. 181 - 183, fig. 3).

Length: abd. + app. 30, hw. 22.7 mm.

Female unknown.

This new species is closely allied to *P. chrysopus*, SELYS, both in the general wing-structure and the colour-pattern of the abdomen, as in regard to the structure of the anal appendages of the male. It differs very strikingly in the colour of the legs and in details of the thoracic colour-pattern, which, in *chrysopus*, are very constant characters (fig. 4 a).

I have much pleasure in naming this species after Dr. P. BUWALDA, who as a botanist took great interest in collecting insects as well.

Podolestes coomansi, sp. n. (fig. 4 c, 5).

Material studied: — 17 ♂, 17 ♀ (4 ♂, 6 ♀ juv.), S.E. Sumatra, Palembang Residency, Palembang, June 11-July 15, Aug. 1-18, Sept. 22-25, Nov. 2-27 and Dec. 11, 1937, L. COOMANS DE RUITER leg. Holotype ♂ and allotype ♀, Palembang, Sept. 25, 1939.

Male (ad.). — Labium bluish- or yellowish-white. Labrum, mandible-bases, anteclypeus and genae pale greenish- or bluish-white, this colour narrowly continued upwards against the margin of compound eyes; labrum shining, finely bordered with brown anteriorly. Postclypeus and frons dark bronzy-brown, lustreless; vertex and epicranium dull metallic-green. Torulus of antennae blackish-brown surrounded by a paler area which extends rearwards and a little inwards as an indistinct, slightly curved, rusty-brown stripe, ceasing on the outer side of each lateral ocellus. Antennae dark brown, pedicel pale brown, darkened apically. Occipital plate with two small pits, one on each side. Rear of the head black, pruinose.

Prothorax clear blue, anterior and posterior lobes dark brown, propleurae pale vinaceous-fawn (RIDGWAY), slightly pruinose.

Synthorax dull bronzy-black with slight greenish reflections above. Dorsal pale markings sharply defined, and of a delicate calamine-blue. Ante-alar

triangles filled in with blue. The sides, beyond the humeral suture, are less vividly coloured, usually burn blue or light glaucous blue with two parallel, oblique, tawny bands which at times are very indistinct (fig. 4 c). Metepimeron and under surfaces pale glaucous blue, thinly pruinose in aged individuals.

Legs vinaceous-buff, the tibiae usually rather more pale olive-buff; spines, and apices of all femora, dark brown.

Wings very different in shape from those of *orientalis, chrysopus* and *buwaldai,* more abruptly expanded beyond the petiole, decidedly broader and with the apices broadly and rather abruptly rounded [1]). Distance between base of wing and Ax_1 only little longer than the space between Ax_1 and Ax_2 (about $1\frac{1}{3}$ in fore wing, less than $1\frac{1}{2}$ in hinder wing). Quadrilateral much longer than in *orientalis;* costal side in fore wing twice as long, and in hind wing almost three times as long as distal side. Two postquadrangular antenodal cells in all wings. Pterostigma light to dark brown, distinctly shorter than in *orientalis.* Nodal index $\frac{15-18}{14-18}$.

Abdomen short, shaped and coloured much as in *orientalis.* Segm. 1 pale brown, sides bluish-white; 2 with the dorso-basal calamine-blue mark slightly less deeply indented posteriorly, sides pale blue. Remaining segments similar to *orientalis.* Segm. 7 - 10 less obscured than in that species and with traces of blue mid-dorsal spots at extreme base only. Tenth segment roof-shaped, dark brown above; sides of 9 and 10 indistinctly marked with pale blue.

Sup. anal apps. dark reddish brown, apical third black. Basal third of inferior pair yellow, the remainder shining black. Superior pair shorter than the inferiors, of simple structure; apices truncated. Inferior pair broad and contiguous basally, thence narrowed and somewhat outbent on middle, finally again widened and provided interiorly with a stout tooth-like projection that meets its fellow of the opposite side so as to embrace an oval notch; apices strongly divergent, bluntly pointed; seen from the side the appendage thickens to a knob whose upper surface is hollowed out in part and bears a small corrugated area, which, in aged individuals, is densely covered with a whitish, granular, pruinescence (fig. 5).

Female (ad.). — Closely similar to the male in colour and markings, but abdomen more robustly built.

The dorsum of the synthorax is raw umber instead of bronzy-black, a narrow stripe over the median carina being Sanford's brown in colour. Mesepi-

[1]) Neither MUNZ's nor RIS's figures of the wings of the suposed ♂ and ♀ of *P. orientalis* agree exactly with those of true examples of this species from Borneo, Billiton and South Sumatra, described by me in a previous paper (*loc. cit., antea*). In our series both pairs of wings are narrower and decidedly more pointed apically than it would appear from these illustrations. On the other hand, the apices of the wings of *P. coomansi* are still more rounded off than in the two specimens of *orientalis* examined by MUNZ and RIS, so that there may exist yet another Malaysian species of *Podolestes,* intermediate in this respect between *orientalis* and *coomansi.* (See MUNZ, Mem. Amer. Ent. Soc. 3, Philad. 1919, pl. 10 fig. 60; and RIS, Zoöl. Meded. Leiden, 10, 1927, p. 15 - 16, fig. 7).

meral blue patches (antehumeral spots), very slightly larger than in the male, only little longer than broad.

Wings hyaline or slightly enfumed with obscured border beyond *pt* in old specimens; similar in shape to the male or even a little broader. Neuration as in the opposite sex. Nodal index $\frac{13-16}{14-16}$.

Abdomen coloured similarly to the male. Apical segments dark brown, almost black in old specimens, with bronzy-green or -blue reflections. Blue basal spot of segm. 2 only shallowly indented posteriorly, those on 3 - 7 slightly

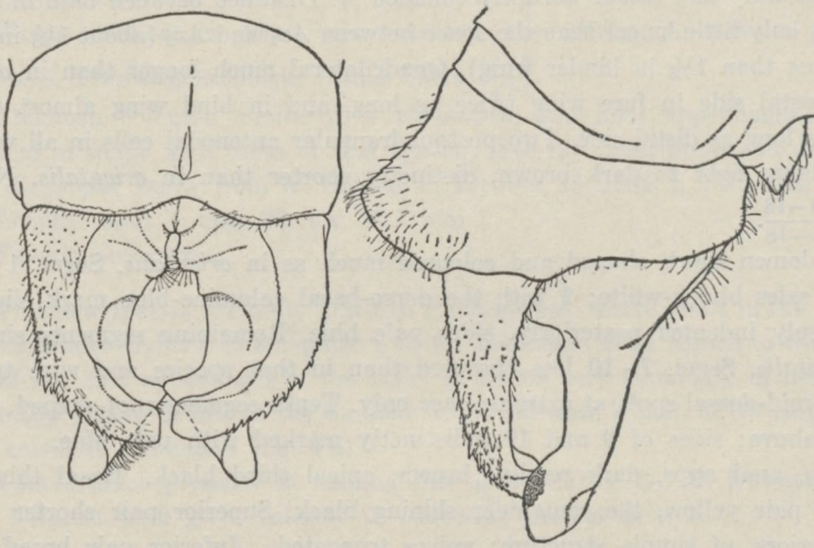


Fig. 5. *Podolestes coomansi*, sp. n. ♂. Anal appendages, dorsal view and right side.

enlarged and all blue mid-dorsally. Segm. 8 with narrow, complete, blue basal annule, the blue colour extending finely along the mid-dorsal carina as far as the middle of the segment; 9 with the blue basal annule still narrower, incomplete laterally, but with the median off-shoot stouter, extending almost to end of segment.

Anal appendages almost as long as segm. 10, rather swollen, but tips acutely pointed. Valves brown, of simple structure, not surpassing end of segm. 10.

Length: ♂ abd. + app. 29 - 31.5, hw. 22 - 24; ♀ 27.5 - 29; 23.8 - 25 mm.

This fine new species is chiefly remarkable for its colouring and for the peculiar, broadly rounded wings. The ♂ is easily distinguished from *P. orientalis* SELYS, by the different shape of its anal appendages, whilst the ♀ resembles the ♂ in that the antehumeral blue bands on the dorsum of the mesothorax are in the form of isolated, oval (or wedge-shaped) patches, whereas in the ♀ of *orientalis* they are band-like, widest ventrally and bluntly pointed above, occupying the lower two-thirds of the mesepisternite (fig. 4 d).

Named in honour of Mr. L. COOMANS DE RUITER, of Manado (Celebes), in recognition of his continuous help and activity.

Fam. PLATYSTICTIDAE.

Drepanosticta barbatula, sp. n. (fig. 6).

Material studied: — E. B o r n e o, N. Koetai, Sangkoelirang distr., Batoe Besi, June 1937, M. E. WALSH leg. H o l o t y p e in the Buitenzorg Museum.

Male (ad.). — Labium pale yellow, tips of lateral lobes brown. Labrum and anteclypeus creamy greenish-white; labrum with the anterior border sharply defined black. Mandibles shining black, upper angle (between labrum and anteclypeus) filled up with a triangular creamy-white spot. Postclypeus shining bronzy-black, finely and transversely striate. Frons and vertex bronzy-black with slight lustre; epicranial lobes dull bronzy-black, rear of the head shining black with purplish reflections. Antennae with the first joint blackish-brown, second joint light brown, the remaining joints missing. Parorbital and transverse postoccipital carinae well developed, the former narrow but rounded, the latter acute, without angulate lateral extremities.

Prothorax chrome-yellow intermingled with green; a deep black spot over the middle, widest posteriorly and almost pointed anteriorly, ceasing at base of anterior lobe and covering the median third of posterior lobe (this dorsal mark almost identical in shape to that of *D. attala* LIEFT., *cf.* Treubia, 14, 1934, p. 472 fig. 2, ♂). Propleurae bronzy-black. Posterior lobe short and broad (still shorter than in *attala*), of simple structure, depressed, hind margin perfectly straight in dorsal view, side-portions evenly rounded.

Synthorax, as far down as the first lateral suture, including the mesinfraepisternum, shining greenish bronzy-black with slight coppery reflections on mesepimeron. Sides light ochreous, intermingled with green, with a strongly contrasting black stripe joining the second suture, tapering ventrally, at extreme dorsal end; this stripe is about twice as wide as the metepisternal pale band, but soon diminishes in width, attaining only half its width at level of the spiracle, which it does not include; posterior limit of this black stripe rather diffuse ventrally. Metepimeron for the greater part and under surfaces pale yellow or whitish. Ante-alar triangles pale-coloured (blue in life?).

Legs pale; coxae and trochanters pale yellow; femora somewhat darker with an irregularly broken stripe along exterior surfaces, and with traces of two pale brownish bands; knees blackish. Tibiae and tarsi dirty ochreous, tibiae obscured basally and distal fourth of last tarsal joint black. Claws reddish; spines all brown.

Wings hyaline. Accessory basal postcostal nervure situated midway between base of wing and Ax_1. *Ac* oblique, placed midway between Ax_1 and Ax_2; it meets the wing-margin well before the production of the proximal side of *q*, joining *Ab* at margin under an obtuse angle in all wings. *Ab* almost 1½ times longer than *Ac*. Cu_1 reaching the hind margin at 4 cells distal to level of subnodus. Postnodals 12 in all wings. M_3 arises slightly distal to subnodus in all four wings, *Rs* between nodus and Px_1. M_2 originates at the 6th or 7th postnodal in fore, at the 6th in hinder wing. M_a 2 - 3 cells distal to M_2 in fore as well

as in hinder wings. Two postquadrangular antenodal cells. Pterostigma jet-black surrounded by a very fine pale line, about 1¾ to 2 times longer than high, slightly widened distally; costal side only very little shorter than anal side; proximal angle rather acute, distal side slightly convex.

Abdomen enormously drawn out and very slender, apical segments strongly dilated. Segm. 1 - 2 brownish above, greenish-yellow aside; dorsum of 2 blackish basally and with a yellow longitudinal mid-dorsal stripe, widest basally and fading away posteriorly; 3 - 7 with narrow yellow basal rings, thence brown, becoming black apically. Segm. 8 - 10 deep black, lateral tergal margins of 8 broadly yellow; 9 with two widely distant squarish blue spots, one on each side of the middle, reaching half the length of segment; 10 black. Membrane between segm. 9 and 10 also blue.

Anal appendages, superiors about twice as long as segm. 10, moderately stout; basal part black, hollowed out interiorly and strongly inwardly curved; distal part yellowish, rather abruptly downbent. A small but very acute spine projects from the inner (mesial) margin of the dorsal surface. Proximal portion of distal part of superior appendage expanded and slightly hollowed out, shining yellow framed in black; from the exterior surface originates a dense brush-like bunch of stiff ochreous hairs, placed in a row and directed backwards like a whale's beard; distal portion of same cylindrical, dull ochreous in colour. Inferior appendages pale ochreous, slightly obscured apically, bent at first upwards, then outwards and finally twisted and bent upwards again. At about half-way its length each appendage carries a strong acute spine, arising from its inner surface and directed obliquely upwards, inwards and a little backwards (fig. 6).

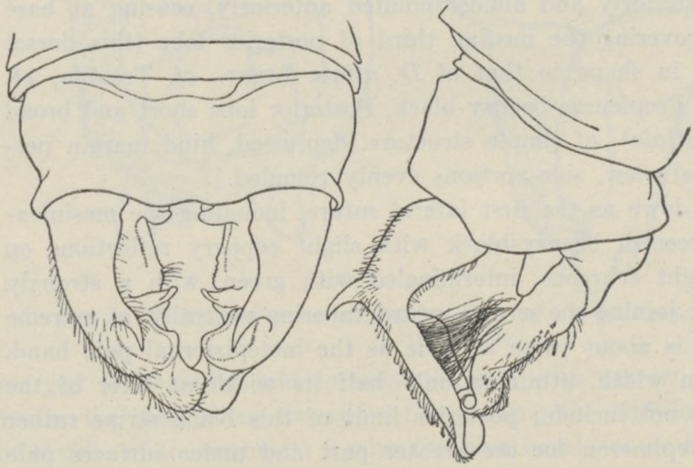


Fig. 6. *Drepanosticta barbatula*, sp. n. ♂. Anal appendages, dorsal view and right side.

Length: abd. + app. 48, hw. 24.5 mm.

Female unknown.

This new species is probably most closely related to the *rufostigma*-group of *Drepanosticta*, but it is abundantly distinguished from all Bornean species of this group by the dense brush-like row of hairs on the innerside of the superior appendages of the male. In this respect *barbatula* approaches a small

group of Malayan species, described by Dr. LAIDLAW, which are remarkable for the presence on the superior anal appendages of a curious process, which itself carries a pencil-like brush of long hairs. The lower appendages in these species are of very complex structure, differing widely in shape from those of *barbatula.* Our new species is also peculiar for the extreme length of the abdomen.

D. barbatula is the tenth species known to occur in Borneo.

Fam. PLATYCNEMINIDAE.

Coeliccia arcuata, sp. n. (fig. 7 - 8).

Material studied: — 2 males, 3 females, E. Borneo, N. Koetai, Sangkoelirang distr., Kariorang, Batau Besi and Babi Djoeton, April 1934, May-June, 1937, M. E. WALSH leg. Holotype ♂ and allotype ♀, Batau Besi, May-June, 1937, in the Buitenzorg Museum.

Male (semiad.). — Labium pale orange-yellow. Labrum wholly black. Mandible-bases, genae and anteclypeus bright blue. Postclypeus, frons and vertex black, postclypeus very shining, base and apex of second joint of antennae and a pair of elongate transverse marks just posterior to the antennae, on either side connecting each lateral ocellus with the margin of compound eye, blue. These head-marks are irregular in shape, rather expanded mesially, narrower and linear laterally. Remainder of head black, save for a pair of very small, transverse, blue postocular spots, restricted to the middle of the epicranial lobes and just visible in dorsal view.

Prothorax with anterior and posterior lobes black, middle lobe blue with a fine median black line. Transverse lateral suture black. Posterior lobe simple, its free margin with a very shallow concavity so as to form a minute obtuse-angulate projection on either side of it.

Synthorax bronzy-black above, light orange-yellow at the sides and underneath; antehumeral stripes broad, complete, gently tapering to a point dorsally and ceasing about 0.5 mm before ante-alar triangles, which are black; at the top of either shoulder and outdistancing the stripes, lies an oval yellow spot. On the side of the thorax a black line, narrowly connected dorsally with the black of the mesepimeron, on the second lateral suture, stopping short 0.5 mm before the spiracle.

Legs with the coxae and trochanters pale orange-yellow. Femora yellow with fine blackish exterior line and with the knees also obscured; tibiae and tarsi dirty yellowish, tibiae finely black interiorly and with black apices, distal half of last tarsal joint and claws black. Spines brown.

Wings hyaline. Neuration very similar to *flavostriata,* LAID. Costal side of *q* a trifle longer in both pairs of wings, and hence distal side slightly less oblique than in that species. Pterostigma blackish-brown, shaped much as in *flavostriata* but a trifle longer, and costal side very slightly shorter than anal side. 14 postnodals in fore wing, 13 in hind wing.

Abdomen slender. Segm. 1 bright yellow, with a thick median line of black, 2 yellow-brown, paler below, with narrow black apical ring; 3 - 6 each with

an indistinct, transverse basal yellow ring, interrupted mid-dorsally (most conspicuous on 3), and narrow black apical rings. The remaining segments progressively darker, 9 - 10 black; 9 with a large blue dorsal patch, bluntly pointed basally, and 10 with a mid-dorsal point of the same colour, at extreme base. Articulation between 9 and 10 likewise blue.

Fig. 7. *Coeliccia arcuata*, sp. n. ♂. Anal appendages, dorsal view and right side.

Anal appendages black, superior pair longer than segm. 10, inferiors a trifle longer than the superiors. Superior pair cylindrical, rather stout, very slightly incurved in dorsal view, evenly but strongly downbent in side-view; each carries a short, acute, internal tooth (not visible in dorsal view) at the end of its basal fifth, which is directed ventrad and slightly basad. Inferior appendages slender, cylindrical, incurved apically (fig. 7).

Female (ad.). — Differs from the male only in details of coloration and in the shape of the prothorax. Posterior lobe of prothorax shaped as shown in fig. 8, the median division of the lobe depressed. Antehumeral stripes and metepisternum blue.

Wings with $\frac{12-14}{11-13}$ postnodals.

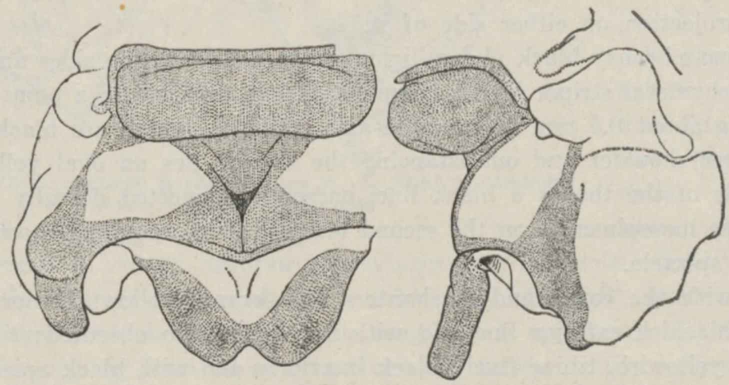


Fig. 8. *Coeliccia arcuata*, sp. n. ♀. Prothorax, dorsal view and right side.

Abdomen coloured as in male. Distal $^2/_5$ to $^1/_3$ of segm. 8 entirely, and a thick stripe bordering the tergal margin, bright blue; 9 and 10 and anal appendages wholly black. Valves very long, with slightly convex ventral border, projecting beyond apex of segm. 10 for almost twice the length of this segment.

Length: ♂ abd. + app. 35 - 35.5, hw. 20.5 - 21; ♀ 32 - 36.5 (incl. valves), 21 - 24 mm.

This species falls in LAIDLAW's Group 3, of *membranipes* (RAMB.), and seems to find its nearest allies in *flavostriata* LAID., *campioni* LAID., *lieftincki* LAID., and the species next to be described as *coomansi*, sp. n. [1]). It is easily distinguished from all these by the different shape of the ♂ anal appendages and the structure of the ♀ prothorax.

Coeliccia coomansi, sp. n. (fig. 9 - 10).

Material studied: — 2 males, 1 female (ad.), W. Borneo, Singkawang, Mt. Poteng, 400 m alt., Jan. 31, 1932 (holotype ♂ and allotype ♀), April 1, 1934, L. COOMANS DE RUITER leg., in the Buitenzorg Museum.

Male (ad.). — Head coloured as in the preceding species (*arcuata*, sp. n.), but lower margin of mandible-bases bordered with black and basal half of labrum sharply defined pale blue. Postclypeus black, very shining.

Prothorax with anterior and posterior lobes black, except the side-edges of the anterior lobe, which are yellow; middle lobe orange-yellow with a fine median black line and with a thick black stripe over the lateral suture. Posterior lobe with a very shallow median concavity.

Synthorax bronzy-black above, ground-colour uniform orange-yellow including the antehumeral stripes and the shoulder-spot, the former being less pointed dorsally than in *arcuata*. On the side of the thorax the black stripe joining the second suture is shorter, rather tapering ventrally and ceasing midway between upper margin and the spiracle.

Legs coloured similarly to the preceding species.

Wings hyaline. Neuration as in the previous species. Quadrilateral identical in shape to *flavostriata* [2]). Pterostigma blackish-brown, shaped exactly as in *flavostriata*. 13 - 15 Postnodals in fore wing, 13 - 14 in hind wing.

Abdomen long and slender. Colouring similar to *arcuata*, but terminal segments entirely black.

Anal appendages black, of slender build; superior pair almost twice as long as segm. 10, inferiors distinctly longer than the superiors. Superior pair forcipate in dorsal view, straight in side-view, flattened dorso-ventrally towards the

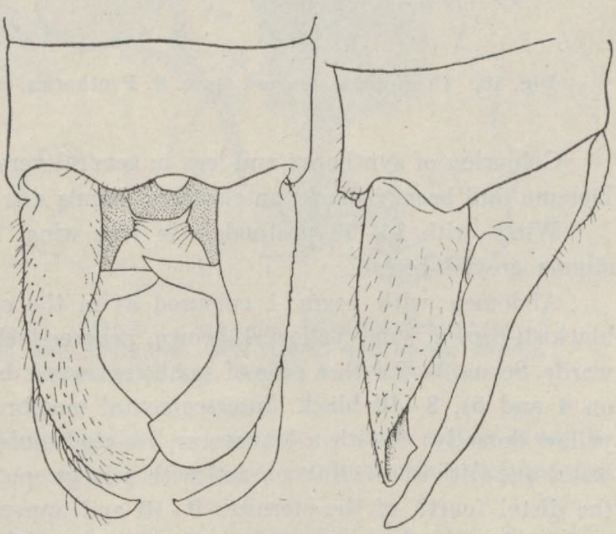


Fig. 9. *Coeliccia coomansi*, sp. n. ♂. Anal appendages, dorsal view and right side.

[1]) Cf. F. F. LAIDLAW, A Revision of the genus *Coeliccia*. Rec. Ind. Mus. 34, 1932, p. 7 - 42, 3 pls.

[2]) Cf. F. F. LAIDLAW, P. Z. S. London, 1918, p. 223 fig. 1 (wings ♂).

free extremity; each carries a very robust pointed internal spur slightly before the middle, which is directed mesiad almost under a right angle. Inferior appendages very slender, cylindrical, incurved apically (fig. 9).

Female (ad.). — Head coloured as in the male, but labrum wholly black. Pale marks on dorsum of prothorax reduced to paired, greenish-yellow spots on the middle lobe and a yellow patch of the same size as the dorsal spots on either side of the anterior lobe. Posterior lobe strongly modified, carrying an enormous, mid-dorsal, bladdery structure which projects obliquely upwards and backwards; this projection is wedge-shaped in profile view and rounded off dorsally, and in frontal view appears to consist of a single very broad median lamella, roughly triangular in outline, convex anteriorly and folded together to the long axis of the body, with the free posterior angles curved towards each other and meeting in one point, enclosing an oval opening when viewed from above (fig. 10).

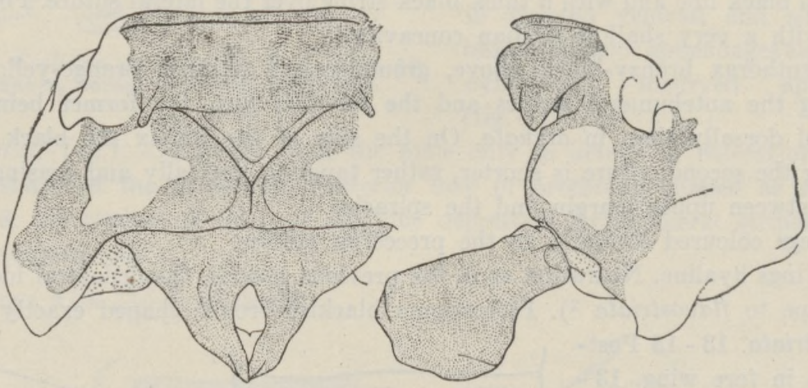


Fig. 10. *Coeliccia coomansi*, sp. n. ♀. Prothorax, dorsal view and right side.

Colouring of synthorax and legs in general very similar to that of the male. Dorsum dull bronzy-black, antehumeral bands a trifle broader, greenish-yellow.

Wings with 14 - 15 postnodals in fore wing, 13 - 14 in hind wing. Pterostigma greyish-brown.

Abdomen with segm. 1 coloured as in the opposite sex, dorsum of 2 - 7 blackish-brown, sides yellowish-brown, progressively darker from before backwards. Segm. 3 - 5 with a pair of small transverse basal yellow streaks (vestigial on 4 and 5), 8 - 10 black. Intersegmental membranes between 7 - 8 and 8 - 9 yellow dorsally; 8 with a transverse, isolated bluish-green band, occupying the distal one-fifth of the dorsum and with a large spot of the same colour covering the distal fourth of the sternite; 9 - 10 and appendages black.

Anal appendages conical, pointed, shorter than segm. 10. Valves black, ventral margin slightly convex, tips yellowish, projecting beyond apex of segm. 10 for about the length of this segment.

Length: ♂ abd. + app. 36.5 - 38, hw. 22; ♀ 35.5 (incl. valves), 23.5 mm.

Coeliccia octogesima, SELYS (fig. 11 - 12).

1863. SELYS, Bull. Acad. Belg. (2) 16, p. 157-158. — ♀ Singapore (*Trichocnemis*).
1886. SELYS, Mém. cour. Acad. Belg. 38 (4), p. 117 - 118. — ♀ Singapore (*Trichocnemis*).
1932. LAIDLAW, Rec. Ind. Mus. 34, p. 40 - 41 (orig. descr. quoted).

Material studied: — 1 ♀ (ad., holotype), labelled: "Sing". (round, white), "Mal. W." (yellow, SELYS's hand), "*Tr. octogesima* S." (yellow, SELYS), in the Brussels Museum.

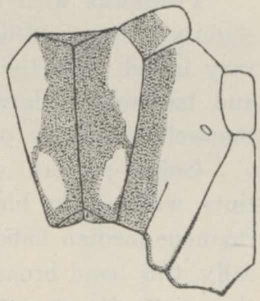


Fig. 11. *Coeliccia octogesima* (SELYS), ♀ holotype. Colour-pattern of synthorax.

The type of this species is a ♀ in the Brussels Museum collection; and LAIDLAW's type-designations in this author's revision of the genus *Coeliccia*, should be transposed. (LAIDLAW thinks it very unlikely that the two sexes described by DE SELYS should be conspecific).

I have made sketches in the Brussels Museum of the prothorax, the quadrilateral spaces of fore and hinder wings, and of the colour-pattern of the synthorax of the type,, and I find these details well agreeing with those of a fine series of females collected by Mr. COOMANS DE RUITER in western Borneo. The last-mentioned examples I had associated with males from the same locality, identified by me as *C. macrostigma*, LAIDLAW, with some misgivings. According to LAIDLAW (*loc. cit.*), the ♀ of *macrostigma* (from Baram, Sarawak) is destroyed, which is extremely unfortunate. Since my specimens of *macrostigma* from West

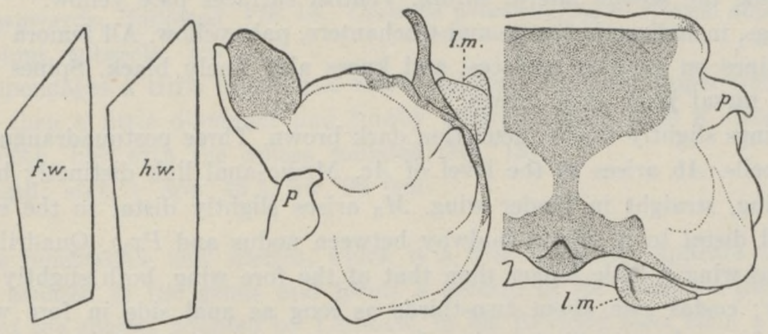


Fig. 12. *Coeliccia octogesima* (SELYS), ♀ holotype. Quadrilateral space of fore and hind wing (left), and prothorax, left lateral and dorsal aspect. *p*, lateral process of middle lobe; *l.m.*, lamina mesostigmalis.

and East Borneo differ a little from the descriptions of that sex as given by LAIDLAW, I hope to describe in detail both sexes of our series in a forthcoming paper on Bornean dragonflies.

The middle lobe of the prothorax of the type of *octogesima* carries on either side a tooth-like, sub-acute lateral process (*p*), which rises close behind the junction of the anterior and median lobes, as in other species of the *membranipes*-group. The lamina mesostigmalis is indicated in fig. 12 as *l.m.*

Coeliccia palawana, sp. n. (fig. 13).

Material studied: — 1 male (ad., holotype), Philippine Islands, P a l a w a n Id., Alfonso XIII, March 6, 1935. K. KUWASIMA leg., in the Leiden Museum.

Male (ad.). — Labium yellow. Face, anterior to the fronto-clypeal suture, entirely Lumiere blue. Postclypeus black. Antennae and frons, as far upwards as the median ocellus, rusty-brown (ferruginous, after RIDGWAY). Vertex dark blue-green, epicranium Lumiere blue. Rear of the head greyish-blue.

Prothorax with the anterior and posterior lobes ferruginous, middle lobe slightly darker mid-dorsally; propleuron Lumiere blue. Posterior lobe short and very broad, with the hind margin slightly convex, directed obliquely upwards and backwards; lateral angles sharply pronounced, rectangulate, the apices themselves slightly projecting and bluntly pointed in frontal view.

Colour-pattern of synthorax composed merely of rusty-brown and blue tints, whereas the black bands are completely gone. Dorsum with a large ferruginous median band, occupying the inner two-thirds of each episternite; dorsally, this band broadens in a curve that runs parallel to the dorsal margin of the episternite so as to meet the impressed blackish streak at the upper end of the humeral suture, about 0.5 mm below the dorsal margin. Ante-alar triangles rusty-brown. A second band of the same ferruginous colour covers most of the mesinfraepisternite and the lower $^6/_7$ of the mesepimeron; laterally, this band does not reach the spiracle, and dorsally, is cut off obliquely. Lateral third of each mesepisternite, dorsal one-seventh of the mesepimeron, and the whole of the thoracic sides, Lumiere blue. There is, besides, a very narrow rusty-brown line along the second lateral suture. Ventral surfaces pale yellow.

Legs, including the coxae and trochanters, pale yellow. All femora with fine black lines on exterior surfaces, and knees also finely black. Spines and tips of last tarsal joint dark brown.

Wings slightly tinged, neuration dark brown. Three postquadrangular antenodal cells. *Ab* arises at the level of *Ac*. Medio-anal link distinctly broken in fore wing, straight in hinder wing. M_3 arises slightly distal to the subnodus, *Rs* well distal to it (about midway between nodus and Px_1). Quadrilateral of the hind wing a little longer than that of the fore wing, both slightly widened distally; costal side about two-thirds as long as anal side in fore wing, but almost $^7/_8$ as long in hinder wing, hence proximal and distal sides of hindwing quadrangle but slightly divergent. M_2 in fore wing arises at the 8th, in hindwing at the 7th postnodal; M_{1a} in fore wing two cells, in hindwing three cells further distad. Nodal index $\frac{18\ 17}{18.16}$. Pterostigma short and high, subquadrate, deep black in colour; proximal side equal in length to costal side, which is slightly but distinctly shorter than anal side. Anal side markedly, distal side very slightly convex, distal angles almost 90°. Border of the wing-tips entire.

Abdomen with segm. 1 brownish on dorsum, blue aside; 2 light brown with elongate, rectangular blue patch, occupying the dorsal three-fifths and bordered posteriorly by an ill-defined, transverse, dark brown annule, followed by a pale

brown apical ring, the transverse suture being black. Segm. 3 - 7 with narrow, dark brown ring at extreme base, followed by two oblique pale blue streaks (absent on 4 - 7); the remainder of these segments chestnut-coloured, progressively darker from before backwards, and each with quite distinct, pale bluish or whitish sub-terminal rings, broadly interrupted by black on the dorsum of 6 and 7; sides pale brown. Segm. 8 black, the apical fourth sharply defined clear blue. The entire dorsum of segm. 9, the intersegmental membrane, and the whole of 10, blue.

Anal appendages black, superiors bluish-ochreous on middle, distal portion of inferiors chestnut-coloured. Superior pair stout, strongly downbent apically, at first sub-cylindrical, thence greatly compressed for the distal two-thirds of each, apices narrow and tapering in dorsal view, very broadly and somewhat irregularly rounded in side-view, each provided with a short interior sub-apical hook, directed obliquely backwards and downwards, followed by a blunt tubercle. Inferior appendages a trifle longer and much slenderer than the upper pair, thick at base, then a little divergent and finally incurved, each with a strong subapical tooth, but with the apices rounded (fig. 13).

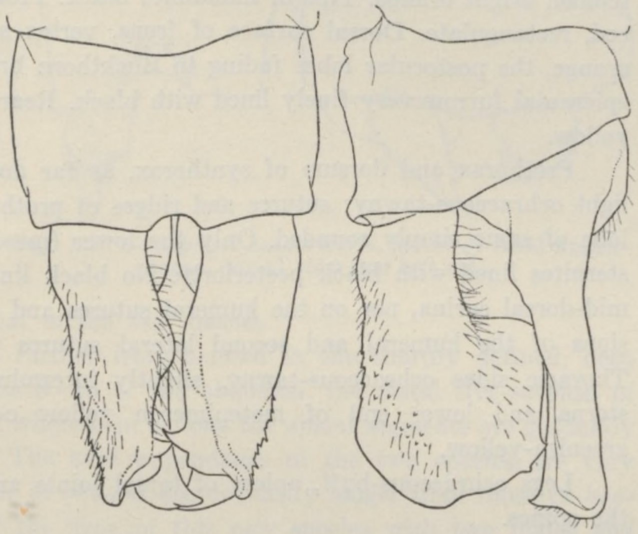


Fig. 13. *Coeliccia palawana*, sp. n. ♂. Anal appendages, dorsal view and right side.

Length: abd. + app. 40.5, hw. 26 mm.

This remarkable new species, which is a true *Coeliccia*, appears to stand entirely isolated in the genus and forms a section of its own. To the arrangement of the species adopted by LAIDLAW, in his Revision (*loc. cit.*), a 'Group 4 of *palawana*' may be added, characterized by the veins M_3 and *Rs* originating well distal to the subnodus, and by the presence of 3 discal cells in all wings.

It seems to be quite distinct from any of the other described species by the highly peculiar colour-pattern of the head and thorax, which is composed of soft rusty-brown and blue tints. *C. palawana* is further remarkable for the shape of the pterostigma and the anal appendages.

I have to thank Mr. KENZO KUWASIMA of Maloong (Basilan I.), who sent me a great many Philippine dragonflies for examination and study, for the presentation of this fine new species.

Fam. AGRIONIDAE.

Ceriagrion hoogerwerfi, sp. n. (fig. 14).

Material studied: — 1 ♂ (ad.), N. Sumatra, Atjeh government, Meloewak, mountain-lake Laoet Tiga Sagi, ca 1500 m alt., April 24, 1937, A. HOOGERWERF leg. Holotype in the Buitenzorg Museum.

Male (ad.). — Labium salmon-buff. The whole anterior surface of the head, as far upwards as the frontal ridge and including the basal two joints of antennae, bright orange. Tips of mandibles black. Frontal ridge sharply pronounced, rectangulate. Dorsal surface of frons, vertex and epicranium ochraceous-orange, the postocular lobes fading to Buckthorn brown. Lateral extremities of epicranial furrow very finely lined with black. Rear of the head pale greenish-yellow.

Prothorax and dorsum of synthorax, as far down as the humeral suture, light ochraceous-tawny; sutures and ridges of prothorax dark brown; posterior lobe of same simply rounded. Only the lower (mesostigmal) ridges of mesepisternites lined with black posteriorly. No black lines along either side of the mid-dorsal carina, nor on the humeral sutures and alar ridges. Dorsal impressions of the humeral and second lateral sutures with a minute black line. Thoracic sides ochraceous-tawny, slightly intermingled with green. Infraepisterna and lower end of metepimeron yellow ocher. Under surfaces pale greenish-yellow.

Legs ochraceous-buff, apices of tarsal joints and claws black, as are also the spines.

Wings light amber, extreme apices smoky. Pterostigma greyish-brown, much longer than high, oblique and parallel-sided. *Ab* arises at level of *Ac* in all wings. Postnodals $\frac{13.12}{11.11}$.

Abdomen grenadine-red, the sides of first and second segments paler. Segm. 6 with a very fine, sharply defined, black apical ring, restricted to the dorsum. Posterior five-sevenths of the dorsum of 7, and the whole of that of 8 - 10, deep shining black, except for a pair of minute reddish dorsal points, on either side of the middle line, near the apex of 7. Sides of 7 - 8 and 10 pale reddish, those of 9 black. Sternites light red, paling to yellowish posteriorly. Intersegmental membranes between 7 - 10 finely yellowish. Posterior margin of segm. 10 pinched and strongly excavated, showing a rounded, $\wedge$-shaped ridge which is minutely denticulated.

Anal appendages much shorter than segm. 10, superiors entirely black, inferiors yellow basally. Superior pair globular, rather twisted and with a small, curved interior sub-apical projection. Inferior pair distinctly longer than the superiors, with inflated bases, tapering, distal third more abruptly narrowing and inclined a little inwards and strongly upwards (fig. 14).

Length: abd. + app. 27.5, hw. 20 mm.

Female unknown.

This interesting new species differs from its congeners, and especially from other red-bodied species, such as *C. erubescens*, SELYS, by the deep black terminal segments of the abdomen. The anal appendages are rather similar to those of *erubescens*, but the superiors are black, and there is only one very small interior tooth. *C. hoogerwerfi* seems to be most nearly allied to *bellona*, LAIDLAW [1]), from Mt. Matang, Sarawak, and Mt. Kinabalu (Borneo). It differs from that species in the longer petiole of the wings, *Ab* in the wings of *bellona* originating well before the level of the cubito-anal cross-vein, whereas in *hoogerwerfi* the two veins are coincident, the position of *Ac* distal to Ax_1 being identical in the two species.

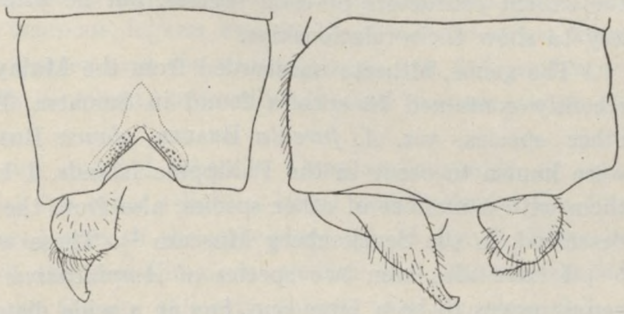


Fig. 14. *Ceriagrion hoogerwerfi*, sp. n. ♂. Anal appendages, dorsal view and left side.

C. hoogerwerfi differs further from *bellona* in the sharply defined, deep black upperside of segments 8 - 10 of the abdomen, the distal five-seventh of 7 being also black in colour, whereas in *bellona* the apical segments are gradually and indefinitely obscured. The anal appendages of the two species are very similar, but the inferior pair of *bellona* are decidedly longer than those of *hoogerwerfi*. I have compared the type of this new species with two males and two females of topotypical *bellona* in my own collection and in that of the Michigan Museum, Ann Arbor, from Mt. Kinabalu. *C. hoogerwerfi*, I think, is also remotely allied to *pendleburyi*, LAIDLAW [2]), from the hill-country of Perak. It is easily distinguished from that species by its orange face, the absence of black lines on the dorsum of the thorax, and by the bright orange-red abdomen. It differs further from *pendleburyi* in the basal portion of the 7th abdominal segment being red instead of black, in the absence of brown basal annules to the base of 7 - 10, and in the short and rounded superior anal appendages, which in *pendleburyi* taper toward the apex, being equal in length to the inferior pair.

Dedicated to Mr. A. HOOGERWERF, the intrepid explorer of the high mountains of Atjeh.

Genus **Amphicnemis** SELYS.

The following synopsis includes notes on some previously described Malaysian species of *Amphicnemis*, of which I have been able to examine the types; descriptions of four new species are also given based on material collected for

[1]) F. F. LAIDLAW, Sarawak Mus. Journal, 2, 1915, p. 274; Journal F.M.S. Mus. 17, 1934, p. 560 - 561, fig. 4 (apps. ♂).
[2]) F. F. LAIDLAW, Journal F.M.S. Mus., 16, 1931, p. 198 - 199, fig. 6 (apps. ♂).

me by Mr. L. COOMANS DE RUITER in western Borneo and Sumatra, by Mrs. M. E. WALSH in eastern Borneo, and by Mr. F. J. KUIPER in the island of Billiton.

The table will, I hope, be of assistance in identifying the Malaysian members of the genus; these have been arranged in such a manner as to indicate the salient characters of each species, but no attempt has been made in the key to show their relationships.

The genus, hitherto unrecorded from the Malay Peninsula and Java, until recently contained 10 species found in Sumatra, Billiton and Borneo. Three other species, viz. *A. furcata* BRAUER, *glauca* BRAUER, and *lestoides* BRAUER, were known to occur in the Philippine Islands. I have compared the types of them with a number of other species, also from the Philippines and as yet undescribed, in the Senckenberg Museum [1]). These will not concern us here.

I have also seen two species of *Amphicnemis* from Celebes, so that the genus proves to be a large one, having a wide distribution in the Archipelago. Many other species in all probability await discovery.

Key to the known Malaysian species.

Males.

1\. Hind margin of posterior lobe of prothorax simply rounded, without any indication of a median spine. 2

—. Hind margin of posterior lobe of prothorax armed with a median spine, or with a small, triangular, median protuberance. 7

2\. *Pt* of both pairs of wings lozenge-shaped and very oblique, colouring of that of f.w. not entirely different from that of the hinder pair of wings. 3

—. *Pt* of both pairs of wings almost square; colouring of that of f.w. dark grey or reddish-grey, broadly surrounded by white (semiad.), or blackish (ad.), and with the entire border white; *pt* of h.w. entirely orange, including the border. Labrum orange-yellow, base brownish with three more or less confluent black points or spots. Femora orange, knees black, no exterior black stripe. Sup. anal apps. almost twice as long as inferior pair, the latter not widened apically. Extremely slender species, abd. + app. 33, hw. 20 - 20.5 mm. Hab.: Borneo. .... **martini**

3\. *Pt* unicolorous in all wings, grey to black, whether or not surrounded by a narrow pale ring, and with the border black. Labrum shining black, its anterior margin yellowish or white. Dorsum of prothorax and the whole of the mesepimeron metallic-green; mesinfraepisternites similarly coloured, or at most partly yellow. Legs variable. Sup. anal apps. distinctly longer

[1]) Recently, NEEDHAM and GYGER (The *Odonata* of the Philippines, II. *Zygoptera*, in Philipp. Journ. Sci. 70, Nov. 1939, p. 239 - 314, 12 pls.), have transferred *A. glauca* and *A. lestoides* to the genus *Pericnemis*, leaving only *furcata* in *Amphicnemis*. From a study of the types of these species I find that they are true *Amphicnemis*, as are also the 5 new species of *Pericnemis*, reported by NEEDHAM and GYGER from these islands. Lastly, *Teinobasis dentifer*, NEEDH. & GYGER, of which I have examined both sexes, should, I think, also be transferred to *Amphicnemis*.

than the width of segm. 10, only little longer than inferior pair, the latter slightly and obliquely widened apically. Species of moderate size. 5

—. *Pt* bicolorous in both pairs of wings, but more obviously so in f.w. than in h.w. Labrum shining black, its anterior margin broadly bordered with yellow. Dorsum of prothorax yellow, with a median, inverted T-shaped, metallic-green mark. Mesepimeron at least partly, mesinfraepisternites entirely yellow. Legs yellow, or ochreous, femora without black exterior stripe, knees black. Sup. anal apps. shorter than the width of segm. 10. Inf. anal apps. antler-like, armed with a robust, upwardly directed process about the middle of each. 4

4. Sup. anal apps. with two rounded tubercles along inner margin of each, one about the middle, the other (slightly larger one) between the first tubercle and the narrowed apex of the appendage (pl. 15 fig. 3). Posterior lobe of prothorax with the metallic-green median spot crescent-shaped, covering most of the lobe. Species of larger, though variable, size; abd. + app. 43 - 45, hw. 24.5 - 27 mm. Hab.: Sumatra. .... **ecornuta**

—. Sup. anal apps. with only one tubercle along inner margin of each, about the middle of the appendage; distal third widened and thickened, forming a scoop-like expansion, which is slightly hollowed out on the inner side (pl. 15 fig. 2). Posterior lobe of prothorax with the metallic-green median spot covering about one-third of the lobe. Species of moderate, though variable, size; abd. + app. 38 - 42, hw. 22 - 24.5 mm. Hab.: Borneo. **amabilis**

—. Sup. anal apps. in profile view more abruptly downbent before the middle of each, ante-median inferior tubercle well visible; the widened distal portion larger than in *amabilis*. Head, prothorax and synthorax coloured similarly to the preceding species. Length: abd. + app. 41.5, hw. 24.5 mm (holotype). Hab.: Banguey Id. (N. Borneo). .... **bicolor**

5. "Labrum metallic bronzy-green. Posterior margin of prothorax produced on either side into a sharply projecting angle. Legs primrose yellow, with a fine black ring at each articulation. Sup. anal apps. ending in a disc so that they have rather a paddle-like shape, the shaft a little bowed with a small dorsal tooth at its middle. Abd. + app. 34, hw. 19 mm." (orig. descr.). Hab.: Borneo (not seen). .... **remiger**

—. Labrum shining black, its anterior margin yellow, or white. Posterior margin of prothorax with rounded side-edges. 6

6. Posterior lobe of prothorax evenly rounded on middle. Femora pale ochreous with sharply defined black apical rings, but without black exterior stripes. The metallic-green colour on dorsum of synthorax surpasses the first lateral suture postero-dorsally and forms an angular off-shoot that terminates against the dorsal margin, about mid-way between first and second lateral sutures. Mesepimeron with minute yellow spot about extreme upper end of humeral suture. Dorsal half of mesinfraepisternites bronzy-green. Sup. anal apps. with the sub-apical tubercle broad and irregular,

well visible in profile view, inner margin between tubercle and apex of appendage markedly concave (Treubia 16, 1937, p. 100 fig. 23). Abd. + app. 33.5 - 36.5, hw. 19 - 20 mm. Hab.: Billiton. .... **kuiperi**

—. Posterior lobe of prothorax slightly projecting on middle, forming a minute, triangular, median protuberance. Femora yellow, striped with black exteriorly and with narrow, black, apical rings. Metallic-green colour on dorsum of synthorax more extensive laterally, extending postero-dorsally to the first lateral suture. No exterior yellow spot about upper end of humeral suture. Dorsal two-thirds of mesinfraepisternites bronzy-green. Sup. anal apps. with the sub-apical tubercle small, acute-angulate in oblique dorsal view, invisible in profile view, inner margin between tubercle and apex of appendage only slightly concave (J. Mal. Br. Roy. As. Soc. 4, 1926, p. 221, fig. 3). Abd. + app. 36 - 37.5, hw. 20 - 21 mm. Hab.: Mentawei Ids. (Siberoet & Pagei). .... **smedleyi**

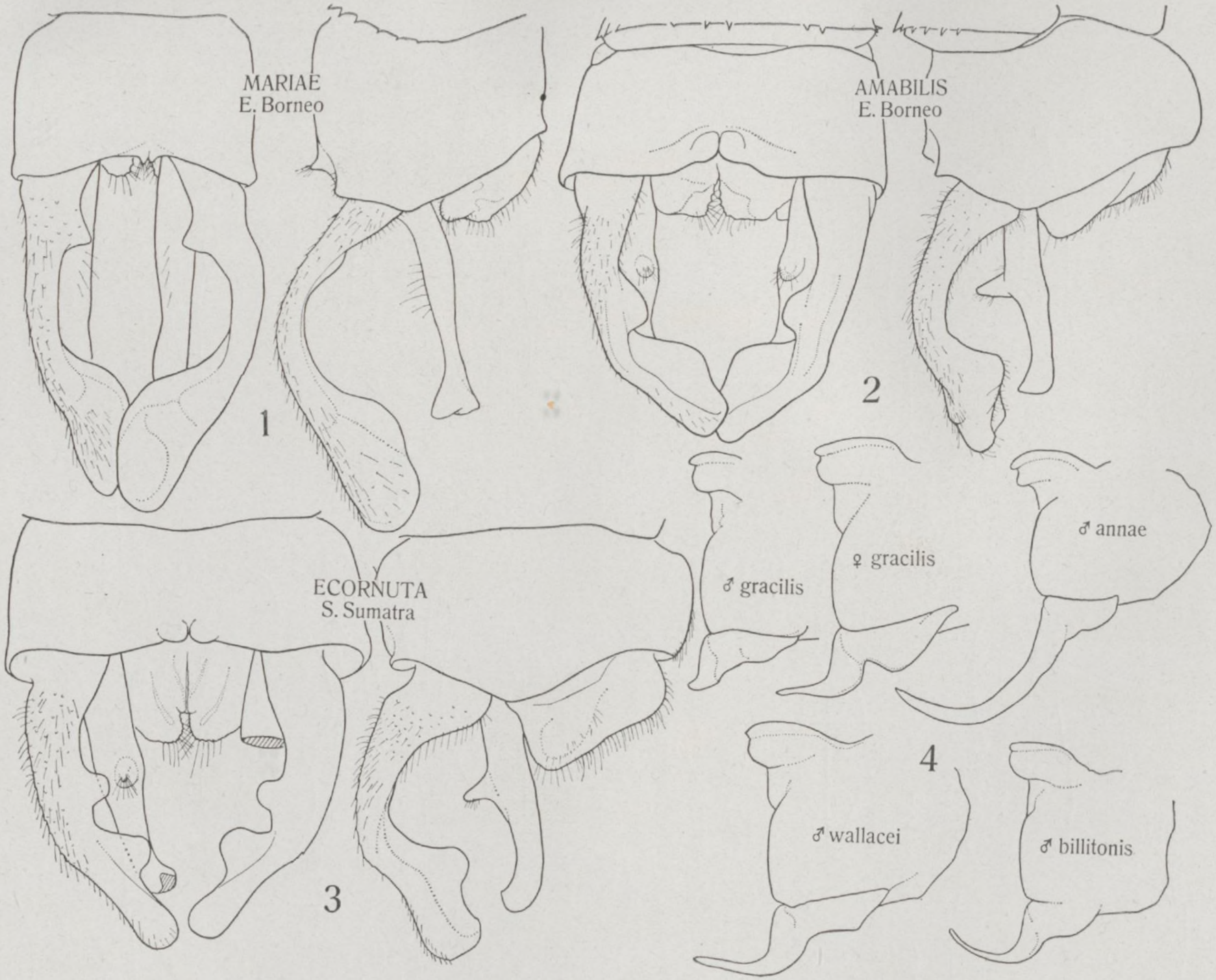
7. *Pt* of f.w. dark grey with paler margin, that of h.w. (adulti!) bright orange, darker in the centre. Labrum for the greater part orange-yellow, spotted with brown or black basally. Antero-dorsal corner of mesepimeron filled up by an elongate, triangular, yellow spot. Posterior margin of prothorax armed with an enormous, median cylindrical horn, nearly vertical, metallic-green at its base dorsally, pale reddish for its basal half, almost hyaline towards the extremity, proportionately much longer than in *annae*, only little shorter in fact than anterior femora; lateral angles of posterior margin obtuse-angulate. Inf. anal apps. antler-like, each with a strong spine directed inwards and upwards at its middle. Small and extremely slender species, abd. + app. 32, hw. 18.5 - 19 mm. Hab.: Borneo. .... **madelenae**

—. *Pt* of f.w. and h.w. not different in colour. Labrum shining black, its anterior margin more or less distinctly yellow or white. Antero-dorsal corner of mesepimeron bronzy-green. Posterior margin of prothorax armed with a median spine of variable size, either very short and triangular, or long and upcurved, though always considerably shorter than anterior femora, metallic-green in colour. Inf. anal apps. simple, without median spine. ... 8

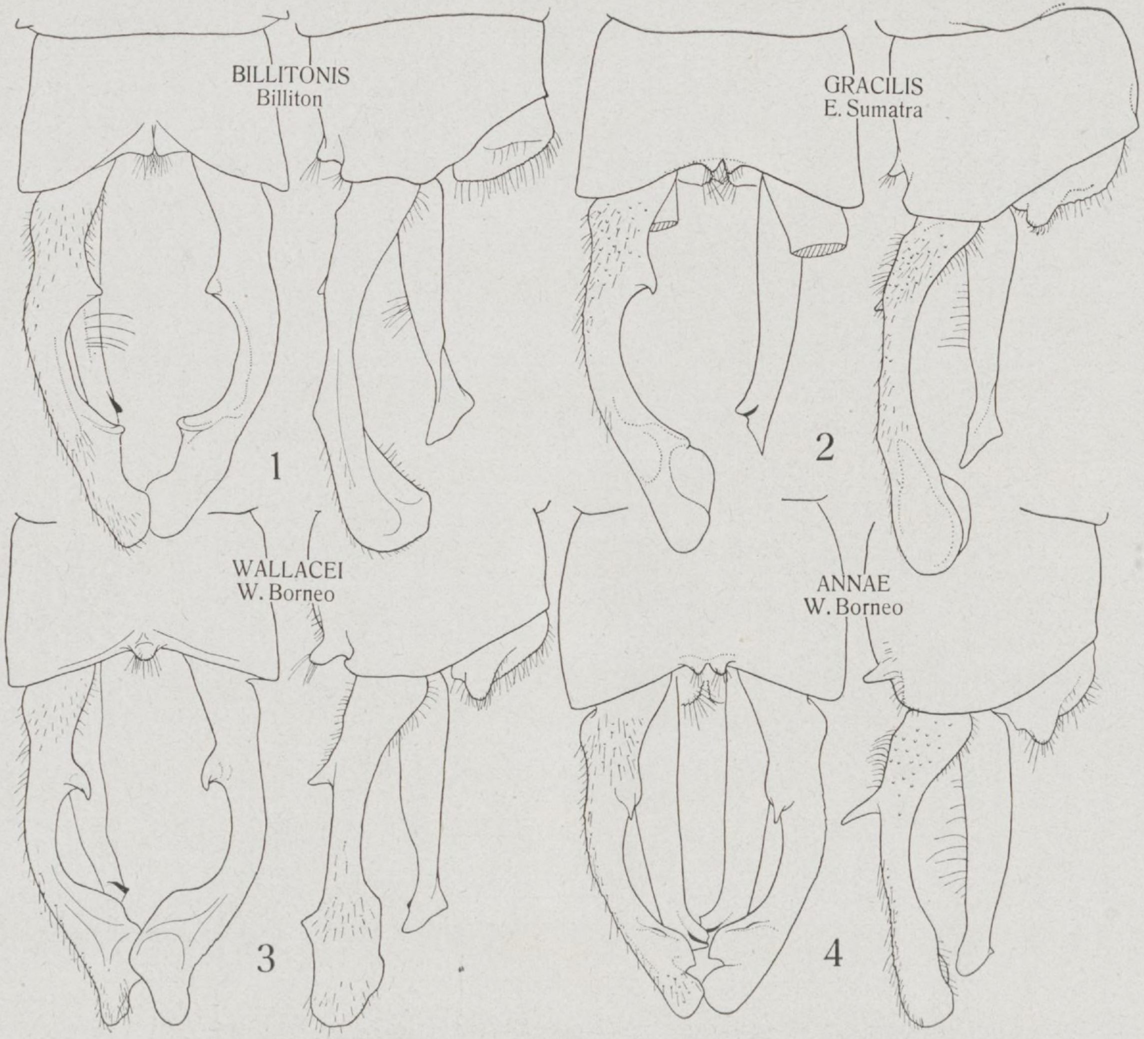
8. Median spine of prothoracic hind-lobe long and slender, hooked upwards and usually forwards. 9

—. Median spine of prothoracic hind-lobe very short, narrowly and bluntly triangular, directed upwards and very slightly forwards; side-angles well pronounced, obtuse-angulate (pl. 15 fig. 4). Pale fascia in front of frons isolated, or almost so, separated from the eye-margin by a black longitudinal streak. 11

9. Median spine of prothoracic hind-lobe much longer than median lobe, evenly upcurved; lateral angles of posterior lobe in dorsal view rounded (pl. 15 fig. 4). Pterostigmata irregular in shape, with costal side distinctly shorter than anal side, greyish-brown, with paler margin. Sup. anal apps. armed with a strong sub-median, dorsal spine; apical part of each appendage in dorsal view with a small but distinct interior incision; apices of inf.



Pl. 15. — Structural characters of Malaysian species of *Amphicnemis*.
1 - 3. Male anal appendages, dorsal view and right side.
4. Right lateral view of prothorax.



Pl. 16. — Male anal appendages of Malaysian species of *Amphicnemis*, dorsal view and right side.

anal apps. abruptly incurved (pl. 16 fig. 4). Femora with the black exterior stripe incomplete and indistinct. Length: abd. + app. 34 - 35, hw. 18.5 - 19 mm. Hab.: Borneo. .... **annae**

—. Median spine of prothoracic hind-lobe about equal in length to median lobe, abruptly upcurved. Sup. anal apps. with the ante-median dorsal projection short, tooth-like or triangular; apices of inf. anal apps. straight or very slightly incurved. Femora distinctly striped with black exteriorly... **10**

10. Pterostigmata deep black, usually without pale margin, costal side only very little shorter than anal side. Median spine of prothoracic hind-lobe strongly curved upwards and forwards; lateral angles of posterior lobe in dorsal view rounded (pl. 15 fig. 4). Sup. anal apps. from base to apex evenly inwardly curved in dorsal view, with the ante-median dorsal projection short and triangular; apical fourth of each in dorsal view, with distinct interior rim, followed by a shallow concavity, tips rather widened and club-shaped in profile view (pl. 16 fig. 1). Length: abd. + app. 34 - 35, hw. 19 mm. Hab.: Billiton. .... **billitonis**

—. Pterostigmata greyish- to dark brown, with fine grey margin; shape irregular, costal side distinctly shorter than anal side. Median spine of prothoracic hind-lobe very similar to that of *billitonis* though usually less strongly forwardly curved; lateral angles of posterior lobe in dorsal view produced as a pair of small, outwardly directed, obtuse-angulate lobes (pl. 15 fig. 4). Sup. anal apps. evenly inwardly bent in dorsal view; tips, after the widened sub-apical part of each appendage, rather abruptly outcurved; ante-median, dorsal projection longer, narrowly triangular and usually somewhat curved (pl. 16 fig. 3). Length: abd. + app. 36 - 38.5, hw. 19.5 - 22 mm. Hab.: Borneo. .... **wallacei**

11. Dorsum of prothorax entirely metallic-green, anterior lobe dorsally with a reddish point on either side of the middle. Metallic-green colour of synthorax reaching as far down as the spiracle. Metepisternum with the dorsal metallic-green spot tapering, its lower margin curving gradually towards the dark colour on mesonotum. Mesinfraepisternites almost wholly metallic-green. Femora with the knees black and with a black exterior stripe. Anal apps. pl. 16 fig. 2, superiors only slightly downbent in profile view. Abdomen very long and slender, abd. + app. 37.5 - 39, hw. 20.5 - 21 mm. Hab.: Sumatra. .... **gracilis**

—. Dorsum of prothorax only partly metallic-green: anterior lobe yellow with a fine black anterior border, anterior third to half of middle lobe also yellow. Metallic-green colour of synthorax ending sharply and in a straight line dorsal to the first lateral suture and hence not reaching the spiracle. Metepisternum with the upper metallic-green spot quadrangular, meeting the dark colour on mesonotum almost under a right angle. Mesinfraepisternites with only the upper half (or less) metallic-green in colour. Femora with the knees black, but lacking a black exterior stripe. Anal apps. pl. 15

fig. 1, superiors strongly downcurved in profile view. Abdomen comparatively shorter, abd. + app. 36 - 37, hw. 21 - 22.5 mm. Hab.: Borneo. **mariae**

Females [1]).

1. Hind margin of posterior lobe of prothorax without any indication of a median spine. 2

—. Hind margin of posterior lobe of prothorax armed with a median spine, or with a small, triangular, median protuberance. 4

2. *Pt* of both pairs of wings almost square, yellow centred with dark grey, the border dark brown. Basal half of labrum reddish brown with three more or less confluent blackish points at extreme base, distal half light yellow. Posterior lobe of prothorax narrow, its hind margin evenly rounded; lateral divisions wanting. Dorsal surfaces of prothorax and mesepisterna, almost as far as the humeral suture, brilliant metallic-green, upper part of sides red (juv.) or blue-green (ad.), succeeded laterally and underneath by pale yellow colouring. Extremely slender species, abd. 31.5 - 34, hw. 20 - 22 mm. Hab.: Borneo. .... **martini**

—. *Pt* of both pairs of wings very oblique. Species of more robust build. ... 3

3. Prothorax dull brown, dark bluish-green or blue dorsally (ad.), or throughout carmine (juv.); posterior lobe rather rectangular in dorsal aspect but with rounded side-edges, margin in side-view somewhat upcurved, distinctly undulated when looked at from behind. Sides of synthorax dark blue or blue-green (ad.), or carmine (juv.). *Pt* dark grey with pale margin, its border black; costal side distinctly shorter than anal side. Abd. 32 - 35, hw. 19.5 - 21.5 mm. Hab.: Billiton. .... **kuiperi**

—. Prothorax pale grey or yellow in colour, dorsum with an inverted T-shaped median, metallic-green mark; posterior lobe short and broad and with hind margin almost straight in dorsal aspect, in lateral view distinctly upcurved and in the form of an acute ridge; lateral divisions of the lobe well-developed, produced laterally as a pair of obtuse- or rectangulate lobes. Synthorax metallic-green dorsally, sides bright yellow (juv.) to greyish-blue (ad.), including the mesinfraepisternites. *Pt* bicolorous in both pairs of wings but more obviously so in f.w. than in h.w., costal and distal borders in f.w. yellow. Large species, *ecornuta:* 41 - 43, 26.5 - 27 mm, hab.: Sumatra; *amabilis:* 36.5 - 40, 25 - 26 mm, hab.: Borneo. .... **amabilis + ecornuta**

4. Median spine of prothoracic hind-lobe small and bluntly pointed, only little longer than the lobe itself, directed almost straight upward; lateral divisions well developed, rounded. Thorax unicolorous green (ad.), or red (juv.), without metallic-green band, mid-dorsally. Abd. 32.5 - 34.5, hw. 21.5 - 22 mm. Hab.: Billiton. .... **smedleyi**

—. Median spine of prothoracic hind-lobe distinctly longer than the lobe itself, usually curled upwards and forwards. 5

[1]) The females of *A. bicolor* (MARTIN), *mariae* sp. n., and *remiger* LAIDLAW, are still unknown.

5. Posterior lobe of prothorax narrow, lateral divisions wanting; median division produced into a long cylindrical horn, broad at base, nearly vertical, metallic-green in colour, tapering rapidly towards the pale-coloured extremity. Labrum orange-yellow, basally reddish-brown spotted with black. Dorsum of pro- and mesothorax, including most of the mesepimera and mesinfraepisternites, brilliant metallic bronzy-green; sides and under surfaces yellow. Legs throughout pale orange. (Red colour-phase unknown). Very slender species, abd. 31.5, hw. 20 mm. Hab.: Borneo. ..... **madelenae**

—. Posterior lobe of prothorax broader, with well developed lateral divisions. Labrum shining black with broad yellow margin. Dorsum of pro- and mesothorax not metallic-green. 6

6. Lateral divisions of prothoracic hind-lobe produced as a pair of long, acute-angulate, bluntly triangular, outwardly directed lamellae; median spine long and slender, curved upwards and gently forwards, about equal in length to the mid-lobe and posterior lobe (without spine) taken together. Pro- and synthorax unicolorous red. (Dark colour-phase unknown). Abd. 34.5 - 35, hw. 20.5 - 21 mm. Hab.: Borneo. .... **annae**

—. Lateral divisions of prothoracic hind-lobe shorter, rectangulate or obtuse-angulate; median spine shorter, about as long as the mid-lobe of prothorax, or even shorter. 7

7. Median spine of prothoracic hind-lobe longer than in male, but distinctly shorter than mid-lobe of prothorax, directed straight upwards and only very slightly forwards; lateral divisions of posterior lobe prominent, strongly convex (pl. 15 fig. 4). Abd. 36 - 39, hw. 22 - 23.5 mm. Hab.: Sumatra. **gracilis**

—. Median spine of prothoracic hind-lobe as long as in male and about equal in length to the mid-lobe of prothorax; lateral divisions less prominent and more angulate. 8

8. Median spine of prothoracic hind-lobe directed almost straight upwards, lateral divisions obtuse-angulate. Abd. 34.5 - 38.5, hw. 21 - 23.5 mm. Hab.: Borneo. .... **wallacei**

—. Median spine of prothoracic hind-lobe curled upwards and forwards, lateral divisions rectangulate. Abd. 33.5 - 36, hw. 20.5 - 22.5 mm. Hab.: Billiton. **billitonis**

Amphicnemis ecornuta SELYS (fig. 15, pl. 15 fig. 3).

1889. SELYS, Ann. Mus. civ. Genova, 7 (27), p. 482 - 483. — ♂ C. Sumatra (Fort de Kock).
1898. KRÜGER, Stett. ent. Zeitg. 59, p. 123-125. — ♂♀ N.E. Sumatra.
1913. LAIDLAW, P.Z.S. London, p. 74 (key).
1937. LIEFTINCK, Treubia, 16, p. 101 (note).

Material studied: — 1 ♂ (semiad.), h o l o t y p e, labelled: "Fort de Kock, Sumatra, WYERS" (yellow, SELYS's hand) under drawer-label: "*Amphicnemis ecornuta* SELYS n. sp." (id.); 1 ♀ (ad.), "DOHRN, Sumatra, Soekaranda" (printed), "*Amphicnemis ecornuta* SELYS ♀ Sumatra KRÜGER" (SELYS's hand). Both speci-

mens in the Brussels Museum. 1 ♂, 1 ♀ (ad.), "DOHRN, Sumatra, Soekaranda" (♀ allotype), in the Stettin Museum. — 1 ♂ (ad.), S. Sumatra, Lampong residency, Tandjong Karang, Kedaton Estate, Wai Rilau, 150 m alt., March 26, 1937, J. VAN DER VECHT leg., in the Buitenzorg Museum.

For a detailed description of this magnificent species the reader is referred to KRÜGER's account.

The ♂ from South Sumatra resembles closely the two other examples, from Fort de Kock and Deli (including the type), with which I have compared it. The type, though fully matured, has obviously been preserved in alcohol and this may largely account for its exceptionally small size; the anal appendages are shrivelled and the colour of the legs has faded to an uniform pale yellow. The only difference which I can make out is that the dorsal anastomosis of the metallic-green juxta-humeral (mesepimeral) fascia (fig. 15) is obliterated in the type. This slight difference I regard as of no importance.

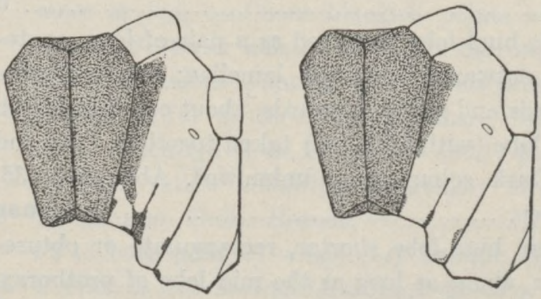


Fig. 15. Colour-pattern of synthorax of *Amphicnemis ecornuta* SELYS, ♂ (Lampong res., left), and of *A. amabilis*, sp. n. ♂ (E. Borneo, right).

The anal appendages of the ♂ differ but slightly from those of *amabilis*, sp. n. (*cf*. pl. 15 fig. 2 & 3).

Measurements of Lampong ♂: abd. + app. 45, hw. 26.5 mm.

Amphicnemis bicolor (MARTIN).

1897. MARTIN, Ann. Soc. ent. France, 66, p. 593 - 594. — ♂ Banguey Id. (*Teinobasis*).

Material studied: — 1 ♂ (ad.), "*Telebasis bicolor* MARTIN, Type, Banguey" (yellow, MARTIN's hand), in the Paris Museum.

This is a true *Amphicnemis*. The type agrees in most respects with *A. amabilis*, sp. n., from which it appears to differ in the shape of the superior pair of appendages. Other details are given in the key to the species. Unfortunately, my notes on the type of this species are incomplete, and I am unable to give a sketch of its anal appendages. Dr. LAIDLAW, who also examined the type, informs me in a letter that the inferior appendages are armed with a robust spine, which is directed upward. The ♀ is unknown.

Amphicnemis amabilis, sp. n. (fig. 15, pl. 15 fig. 2).

Material studied: — 13 ♂, 11 ♀ (mostly ad.), E. Borneo, N. Koetai, Sangkoelirang distr., Kariorang, Pelawan Besar, Batau Besi & Maloewi, April-June, 1937, M. E. WALSH leg., in the Buitenzorg Museum. Holotype ♂ and allotype ♀, Kariorang, April 1937.

Male (ad.). — Labium Maize-yellow. Labrum shining black with broad citron-yellow margin. Mandible-bases, genae, and anteclypeus bright greenish-yellow, as is also an isolated curved stripe in front of frons. Anteclypeus with two black spots, postclypeus wholly shining black. The rest of the head bronze-green above. Antennae brown, first two joints with a bluish spot, third joint with yellow anterior streak. Rear of the head black; a pale blue stripe along the eye-margin, tapering to a point posteriorly.

Prothorax cream-coloured; anterior lobe finely bordered with black; dorsum with a trapezoidal bronzy-green mark traversing the length of the mid-lobe, narrowing to a longitudinal streak against anterior lobe, and broadening suddenly to a transverse, crescent-shaped spot covering the middle one-third of the posterior lobe. Seen from above, the lateral angles of the posterior margin are produced a little, but in side-view they are cut off under right angles.

Synthorax above very brilliant metallic blue-green; mesepimeral (juxta-humeral) lustrous spot, and dorsal anastomosis along upper end of first lateral suture, slightly variable in extent, usually shaped as shown in fig. 15. Mesinfraepisternites, sides and under surfaces bright yellow.

Coxae buff-yellow, femora light cadmium in full-coloured individuals, tibiae and tarsi paler; extremities of all femora and tibiae narrowly ringed with black; apices of tarsal joints and spines also black.

Wings hyaline. Pterostigma very oblique, but with parallel sides, bicolorous. In fore wing the costal and distal border (and the upper half of the proximal border as well) are bright yellow, the lower half of the proximal and the entire anal border being black in colour, whilst the blackish-brown centre occupies only the lower proximal portion of *pt*. In the hinder wings *pt* is blackish-brown, its margin yellow, most distinctly so along costal border, which, itself, is yellow or pale brownish, according to age and maturity. Postnodals $\frac{12-13}{11-12}$.

Abdomen long and slender. Segments 1 and 2 metallic-green above and with narrow black apical rings, clear yellow aside. The succeeding segments are dark metallic-brown, becoming progressively darker (black from 7 to 10); 3 - 7 with very narrow yellow anterior rings, interrupted mesially; sides and under surfaces yellow. Terminal segments rather inflated, deep black with slight metallic-green lustre, hind margin of 10 reddish-brown.

Anal appendages pure white, or pale yellow, shaped as shown on pl. 15 fig. 2.

Female (ad.). — Closely similar to the male and differing only in that the prothorax and the sides of the synthorax are olive-buff or vinaceous-buff (discoloured?) in fully matured examples.

Pterostigmata less definitely bicolorous than in the male and occasionally obscured so much as to present only a yellow costal border to the *pt* of fore wings. Neuration otherwise as in the opposite sex.

Abdomen coloured much as in the male, the yellow anterior rings enlarged, though interrupted mid-dorsally. Segments 8 and 9 each with an irregular yellow or bluish-green side-spot; 10 and anal appendages black. Basal half of genital

valves yellow, distal half black, tipped with yellow, projecting beyond apex of abdomen for about the length of segment 10.

This new species is very closely allied to, if not identical with, *A. bicolor* (MARTIN), from Banguey. *A. ecornuta* SELYS, from Sumatra, is also very similar; and these three species form a distinct section within the genus, characterized by the simple structure of the prothorax in both sexes, the bicolorous pterostigma, the reduction of the metallic-green marks on the dorsum of pro- and synthorax, and by the more compact build of the anal appendages. The males of all three species are peculiar for the presence of a strong spine on the upperside of the inferior appendages.

I have seen a number of undescribed species from Celebes and the Philippines, which seem to fit this section of the genus more appropriately than the Malaysian species-groups of *wallacei* and *martini*.

Amphicnemis annae, sp. n. (pl. 15 fig. 4, pl. 16 fig. 4).

1911. RIS, Ann. Soc. ent. Belg. 55, p. 236 - 237 (key), fig. 5 (♂ apps.). — ♂ (nec ♀ !) W. Borneo (*A. wallacei*).

1913. LAIDLAW, P.Z.S. London, p. 70; 74 (key ♂), pl. 4 fig. 7 (♂ proth.). — ♂ Sarawak (*A. wallacei*).

Material studied: — 1 ♂ (ad.), 2 ♀ (juv., red), W. Borneo, Singkawang, forest-marsh near Tjapkala, Jan. 16, 1934, L. COOMANS DE RUITER leg. Holotype ♂ and allotype ♀ in the Buitenzorg Museum.

This very distinct species has long been known as *wallacei;* but since SELYS's type of *A. wallacei* is indistinguishable from the species described by LAIDLAW as *louisae,* this name unfortunately should be dropped as a synonym of *wallacei.*

Only few specimens of *annae* were known, and no descriptions of it are available in the literature. I believe its position to be closest to *wallacei.* The supposed allotype ♀ of *wallacei,* described by RIS, neither belongs to *wallacei* nor even to *annae,* and I am unable at the present to identify it from the description alone.

The following notes may be added to those given in the key to the species of both sexes:—

Male (ad.). — Labium pale yellow. Mandibles yellow, each with a large, slightly diffuse, triangular, brownish spot upon middle. Labrum shining black, its anterior margin bright yellow and fringed with yellow hairs. Anteclypeus yellow, postclypeus shining black. Frons in front black with two yellow spots, one on each side of the middle. Dorsal surface of head metallic-green. Antennae brown, basal joints striped with yellow anteriorly. Rear of the head black.

Prothorax metallic-green above, anterior lobe with a pair of round orangish spots, one on each side of the middle; propleuron also metallic-green, its lateral border yellow.

Synthorax metallic-green, as far down as the first lateral suture and the spiracle, including the dorsal two-thirds of the mesinfraepisternites and the dorsal fifth of the metepisternites. Sides and under surfaces pale yellow.

Legs yellow, spines brown. Femora pale ochreous, with sharply defined black apical ring; a very diffuse brownish line runs along the distal half of their posterior surfaces (most marked on anterior pair of femora).

Wings hyaline; M_3 arises at the subnodus or slightly distal to it, *Rs* about midway between subnodus and Px_1. Pterostigma greyish-brown with fine yellow margin. Postnodals 12 - 13 in fore wing, 10 - 11 in hind wing.

Abdomen coloured as described for "*louisae*" (= *wallacei*) by LAIDLAW. Tenth segment pale reddish-brown basally and along posterior margin. Anal appendages of the same colour, shaped as shown on pl. 16 fig. 4.

Female (red colour-phase). — Head coloured much as in the opposite sex, but pale areas slightly enlarged. Labrum with the distal half yellow, frons with a complete yellow anterior fascia, and a yellow line along margin of compound eyes.

Pro- and synthorax, and legs throughout scarlet-red. Spine of posterior lobe of prothorax equal in length to that of the male. Ante-alar triangles metallic blue-green. Postnodals 12 - 13 in fore wing, 11 in hind wing.

Abdomen with segm. 10 and appendages whitish; valves also pale-coloured, slightly surpassing end of abdomen.

Apparently a very scarce species.

Amphicnemis wallacei SELYS (pl. 15 fig. 4, pl. 16 fig. 3).

1863. SELYS, Bull. Acad. Belg. (2) 16, p. 153. — ♂ Sarawak.
1877. SELYS, Ibid. (2) 43, p. 128 - 129. — Same specimen.
1913. LAIDLAW, P. Z. S. London, p. 71, 74 (key ♂♀), pl. 4 fig. 5 (♂ proth.), 5a (♂ apps.). — ♂♀ Sarawak (*A. louisae*).

Material studied: — 1 ♂ (semiad.), labelled: "Sar." (round, white), "Borneo W." (yellow, SELYS's hand), "*Amphicnemis Wallacii* D.S. ♂ Surrawak" (brown, SELYS's hand), holotype in the Brussels Museum. — 15 ♂ (mostly ad.), 18 ♀ (3 ad., green, 15 juv., red), W. Borneo, Singkawang, Bengkajang Rd., forest-marsh near Bakoean, near Montrado, and Sempadang, Dec. 19, 1931, July 19 - 20, Aug. 25 - 30, Sept. 16 - 17, Oct. 11, and Dec. 21, 1932, Jan. 16, 1934; 1 ♂ (ad.), W. Borneo, Padang Tikar Id. (Batoe Ampar), Mar. 12, 1931. All L. COOMANS DE RUITER leg., in the Buitenzorg Museum.

A fine series of specimens was obtained by Mr. COOMANS from the marshy forests of West Borneo, and these agree in all essential characters with LAIDLAW's description and sketches of *A. louisae*. A recent examination of the type of *A. wallacei*, in the Brussels Museum, has brought to light that *louisae* is the same species as *wallacei*, and that the supposed examples of *wallacei* recorded by RIS and LAIDLAW in reality belong to a species previously unknown to science, for which I proposed the name *annae*, and of which a description is given above.

SELYS's type specimen, collected by WALLACE, though still in excellent condition, is not quite matured; the anal appendages and the prothoracic spine are exactly identical in structure with those of our series, but the legs are missing.

There are 12 postnodal cross-veins in both fore wings, 11 in the hinder pair. I can find nothing to distinguish our specimens from the type, except that the nodal index varies from $\frac{11-13}{10-12}$.

Apart from the well-marked differences in the shape and armature of the anal appendages, *wallacei* is easily distinguished from *annae* by the much shorter prothoracic spine, the sharply defined black lines along the posterior surfaces of all femora, and by the complete yellow stripe in front of frons, which is not (or only narrowly) interrupted by black in the median line.

Female. — Young individuals of this sex are as vividly coloured as those of *annae*, but the possession of a shorter spine on the prothoracic hind lobe will serve to their easy recognition.

The adult ♀ may be briefly described as follows:—

Head coloured much as in the red form; mandible-bases with a diffuse brownish central spot, basal three-fifths of labrum shining black. Pale fascia in front of frons entire, scarcely constricted on middle. Dorsal surface of head dark metallic bluish-green, or almost lustreless.

Pro- and synthorax dull greyish- to greenish-brown dorsally, growing paler laterally; sides in fully matured examples usually glaucous-green, under surfaces much paler. Ante-alar triangles metallic-green.

Legs, including the coxae, cream-buff; all femora definitely striped with black exteriorly and with the knees also deep black. Spines and extremities of tarsal joints black.

Abdomen with segments 1 and 2 lustrous brown above, each with a terminal metallic-green ring. The rest of the abdomen greyish-brown, pale yellowish below, progressively darker posteriorly, the apical segments (with the exception of 10) being dark brown. Dorsum of 9 with two roundish, pale, sub-apical spots, 10 and appendages entirely greenish-white. Valves also pale-coloured, barely surpassing the anal appendages.

Amphicnemis gracilis KRÜGER (pl. 15 fig. 4, pl. 16 fig. 2).

1898. KRÜGER, Stett. ent. Zeitg. 59, p. 121 - 123. — ♂♀ Soekaranda, ♀ Liangagas (N.E. Sumatra).

1913. LAIDLAW, P.Z.S. London. p. 74 (key ♂♀, not seen).

Material studied: — 1 ♀ ad., defective, "DOHRN, Sumatra, Soekaranda" (a l l o t y p e), 1 ♀ juv., head, prothorax and segm. 7 - 10 of abdomen lost, "Liangagas, DOHRN" (p a r a t y p e), in the Stettin Museum. 7 ♂ (mostly ad.), 18 ♀ (12 ad., blue or green, 6 juv., red), E. S u m a t r a, Palembang, Nov. 8 - 23, 1937, L. COOMANS DE RUITER leg.; 2 ♂, 2 ♀ (ad.), Palembang, Nov. 14, 1937 & April 1, 1938, J. J. VAN DER STARRE leg.; 1 ♂ (ad.), id., Riouw Res., Inderagiri, Pangkalankasai, April 4, 1939, P. BUWALDA leg. All in the Buitenzorg Museum.

This species has not revealed itself since the time of its description.

I am much indebted to Herr Dr. A. KÄSTNER, of the Naturkundemuseum, Stettin, for the loan of KRÜGER's types of *gracilis*, which I have thoroughly

compared with our fine series of specimens and found them well agreeing. The type ♂ from Soekaranda is lost and the authorities of the Stettin Museum were unable to trace it, but fortunately the description of the male is very detailed and the agreement with the Palembang specimens is so close that I have no hesitation in referring them to KRÜGER's species.

Female (ad.). — The adult specimens that I take to be the ♀ of this species are identical with KRÜGER's example. I have made KRÜGER's "mittelreifes ♀" the allotype of *gracilis;* the colours of the thorax of this specimen are faded and the various black spots and stripes mentioned in KRÜGER's description are very obviously due to postmortem decomposition. In our series of females no two examples are exactly alike, the colouring of the dorsal surface varying from cinnamon- or olive-brown to 'medal-bronze' (RIDGWAY), whilst the sides are dark bluish glaucous (or greenish glaucous-blue) in matured specimens. Several females show the same thoracic colour-pattern as KRÜGER's examples; but there are no real antehumeral stripes, and the black spots or stripes are merely apparent. The ante-alar triangles are metallic-green, and the under surfaces pale yellow.

Legs, including the coxae, yellow; femora and anterior tibiae striped with black exteriorly, knees and apices of tarsal joints also black.

The abdomen is coloured similarly to *wallacei* and *annae.*

Female (juv.). — The type of KRÜGER's red colour-phase lacks its head and prothorax, as well as the terminal abdominal segments. Our specimens agree with the description in all respects, except that the prothorax is entirely red.

Nearest to *smedleyi,* LAIDLAW, from the Mentawei Islands, which is probably only a subspecies of *gracilis,* of the main island.

Amphicnemis smedleyi LAIDLAW.

1915. RIS, Tijdschr. Ent. 58, p. 13 - 14. — ♀ Simaloer Id. (*louisae*).
1926. LAIDLAW, J. Mal. Br. Roy. As. Soc. 4, p. 232 fig. 3 (apps. ♂). — ♂♀ Siberoet & Pagai Ids. (*louisae smedleyi*).

Material studied: — 2 ♂ (ad., crushed), 2 ♀ (one ad., one juv.), Siberoet Id., Sept. 1924, C. BODEN KLOSS & N. SMEDLEY, ex coll. F. F. LAIDLAW.

These specimens differ from *wallacei* (= *louisae* LAID.) in a number of characters, which I have enumerated in the key to the species. The ♂ is easily distinguished from *wallacei* by the different shape of the superior anal appendages and by the absence of a prothoracic spine. The ♀ has been described at length by RIS.

This species is obviously most closely related to *gracilis,* KRÜGER, and *kuiperi,* LIEFT., two species in which the prothoracic spine is either also reduced, or absent altogether. Apart from the differences found in the sculpturing of the hinder lobe of the prothorax, the ♂ of *smedleyi* may be distinguished from

that of *kuiperi* by the presence of a black streak to the outer surface of all femora; it differs further from *kuiperi* in the shape of the superior anal appendages, which bear a very close resemblance to those of *gracilis,* being in fact practically identical with those of that species (pl. 16 fig. 2). On comparing *smedleyi* with *gracilis,* these species proved to resemble each other very closely, and I could find no other distinctive features than those mentioned already in the key to the species. Granting the characters of the prothorax to be constant, there should be no difficulty in separating them; but it is doubtful if these differences are of specific significance. In view of the rarity of these extremely delicate species in collections, it seems worth recording the observed differences even on the small series available. Personally I am of opinion that *smedleyi* is only a subspecies of the Sumatran *gracilis,* KRÜGER.

Amphicnemis billitonis, sp. n. (pl. 15 fig. 4, pl. 16 fig. 1).

Material studied: — 6 ♂ (ad.), 15 ♀ (8 juv., red, 7 ad., blue), Billiton I. (west), Tjeroetjoek and Goenoeng Aoer, Sept. 21 - 27, Oct. 3, Nov. 19, and Dec. 24, 1935, April 7, 1936, F. J. KUIPER leg., in the Buitenzorg Museum. Holotype ♂ and allotype ♀: Tjeroetjoek, Dec. 24, 1935.

Obviously most closely allied to *wallacei,* SELYS.

Male (ad.). — Differs from *wallacei* in the following respects:

All but the middle of the anterior margin of labrum shining black. Pale fascia in front of frons broadly interrupted on middle. Metallic-green colour on dorsum of synthorax more extensive laterally and ceasing at the spiracle (*wallacei:* slightly before level of spiracle). Pterostigma blackish-brown or black, without yellow margin in adult specimens (*wallacei:* greyish-brown with distinct yellow margin in both pairs of wings). The structural differences are given in the key to the species.

Anal appendages white, or wax-yellow in the younger male, pale brown tipped with purplish-black in matured individuals (pl. 16 fig. 1).

Female. — The red and blue-green colour-phases are inseparable from those of *wallacei* and *gracilis,* described before. The tip of the prothoracic spine is yellowish or almost hyaline in adult specimens.

Amphicnemis mariae, sp. n. (pl. 15 fig. 1).

Material studied: — 3 ♂ (one ad.), E. Borneo, N. Koetai, Sangkoelirang distr., Pelawan Besar & Kariorang, May-June, 1937, M. E. WALSH leg., in the Buitenzorg Museum. Holotype ♂: Pelawan Besar, May 1937.

Male (ad.). — Head coloured as described for *annae,* but labrum with anterior, ochreous, margin broader and with the yellow fascia in front of frons barely interrupted in the middle line.

Colouring of pro- and synthorax as described in the key. In all three specimens there is a fine comma-shaped yellow spot lying close against

the upper margin of the mesepimeron, on each side of the dorsal end of the humeral suture.

The squarish lustrous spot covering the upper part of the mesepisternum is separated from the dark colour on the mesepimeron by a fine yellow line. Sides and under surfaces pale yellow.

Legs pale yellow, apices of all femora and tibiae, spines and tips of tarsal joints, black.

Neuration identical to the other species of the same group. Postnodals $\frac{13-14}{11-12}$. Pterostigma greyish-brown, with pale yellow margin.

Abdomen coloured as in *wallacei;* distal margin of segment 10 whitish. Anal appendages yellowish-white, shaped as shown on pl. 15 fig. 1.

Female unknown.

This new species is easily distinguished from its allies by the reduction of the metallic-green colour on the dorsum of the pro- and synthorax, and by the anal appendages, which appear to resemble those of *remiger* fairly closely.

Named in honour of Mrs. M. E. WALSH, in appreciation of her constant help in collecting Odonata.

Amphicnemis martini RIS.

1911. RIS, Ann. Soc. ent. Belg. 55, p. 236 (key ♂), 237 - 238, fig. 6 (apps. ♂). — ♂ W. Borneo.

1913. LAIDLAW, P.Z.S. London, p. 72 - 73; 74 (key). — ♂♀ Sarawak.

Material studied: — 5 ♂ (semiad.-ad.), 6 ♀ (2 juv., red, 4 ad., blue), W. Borneo, Singkawang, forest-marsh near Bakoean, Dec. 7, 1931, Febr. 17 - 19, July 19, 1932, L. COOMANS DE RUITER leg., in the Buitenzorg Museum.

Male. — These specimens agree exactly with RIS's account of *A. martini,* save that in the fully adult examples the colour of the pterostigmata of the fore wings is deep greenish-black centred with dark brown and with the border yellow, whilst those of the hinder wings are throughout bright orange. There are $\frac{14-15}{13}$ postnodal cross-nerves. In the semi-adult males the thoracic sides and legs are yellow.

The colour of the tenth abdominal segment varies from yellow to pale blue. Anal appendages wax-yellow to pale brown. Superior pair decidedly shorter than in *wallacei* and allied species, each with a distinct triangular protuberance at about the middle of their length, directed obliquely inwards and upwards, followed by a similar (slightly more robust) triangular expansion, which projects horizontally inwards; the median incision between these two projections (RIS, *loc. cit.* fig. 6) is visible only in oblique dorsal view. Inferior pair of appendages only half a long as the superiors, cylindrical, tapering, slightly divergent, tips evenly and but slightly upcurved.

Female (ad.). — Legs pale yellow, femora striped with black exteriorly and with the extremities also finely black. Anterior pair of tibiae with the basal one-third of the outer surfaces black.

Valves not projecting beyond the apex of abdomen.

Female (juv.). — The red colour-phase of this species is peculiar for the brilliant metallic-green episterna of the mesothorax, which, in the red-bodied females of other species, are of the same colour as the rest of the thorax. There is also a median bronze-green spot on the middle of the prothorax that covers the whole of the posterior lobe as well.

The coxae, tibiae and tarsi are yellowish whilst the femora are red, lacking black exterior stripes.

Amphicnemis madelenae LAIDLAW.

1913. LAIDLAW, P.Z.S. London, p. 71 - 72, 74, pl. 4 fig. 6 (proth. ♂), 6a (apps. ♂). — ♂ Sarawak.

Material studied: — 3 ♂, 1 ♀ (ad.), W. Borneo, Singkawang, forest-marsh near Bakoean, Dec. 7, 1931 and Febr. 17, 1932, L. COOMANS DE RUITER leg., in the Buitenzorg Museum.

The following emendations are necessary to complete the original description of the male and the characters mentioned in the key.

Occiput with a yellow stripe behind the transverse carina.

Prothorax in side-view with the upper half brilliant metallic-green, the lower half pale pearly green, under surface pale yellow. Anterior lobe yellow, its free margin finely bordered with black. Lateral divisions of posterior lobe wanting, side-angles rounded in profile view.

Synthorax, as far down as half-way between humeral and first lateral suture, brilliant metallic-green. A squarish spot of the same colour occupies the upper (anterior) half of the mesinfraepisternites, succeeded posteriorly by a short yellow stripe along the mesepimeral suture. Metallic green spot on upper part of metepisternum roundish and almost isolated.

Coxae pale yellow; femora entirely orange, tibiae and tarsi yellow.

Pterostigmata of fore wings dark grey with pale orange margin and with the border orange-brown; those of the hinder pair (including the border) bright orange, darker in the centre. In the slightly younger male the *pt* of the hinder pair of wings differs but slightly in colour from those of the fore wings.

The anal appendages vary in colour from almost pure white to dirty yellowish, with pink-coloured apices.

Female (ad., allotype, androchromatic). — Differs from the ♂ only in the ground-colour of the thorax being less vividly yellow, whilst the femora are pale orange.

Spine of prothoracic hind lobe directed straight upwards, amply half as long as that of the male, being in fact about equally long as the mid-lobe of the prothorax, bronze-green in colour, its distal half dirty yellowish.

Pterostigmata of fore wings dark greyish-brown, with narrow pale margin, their border brown; those of hinder wings with the yellow margin broader, especially along costal border, which itself is pale brown in colour.

Abdomen coloured as in the opposite sex, intermediate segments pale brown above, 3 - 6 with distinct basal yellow rings, interrupted mid-dorsally. Terminal segments darker brown with purplish reflections above, lacking definite pale spots.

Anal appendages orangish. Valves brown, barely surpassing apex of abdomen.

The extreme delicacy of this rare species is worth mentioning. In the shape of the anal appendages and in the colour of the pterostigma of the ♂, *madelenae* comes nearest to *martini*, from which it differs (among other characters) by the absence of a prothoracic spine in both sexes.

Fam. AESHNIDAE.

Genus **Oligoaeschna** SELYS (= *Jagoria* KARSCH).

Of this genus the following species were known to science:—

O. amata (FÖRSTER). Insekten-Börse, 20, 1903, p. 1 - 2 sep. — Terra typica: Brunei, N. Borneo, ♂.

O. bühri (FÖRSTER). Insekten-Börse, 20, 1903, p. 2 sep. — Terra typica: Brunei, N. Borneo, ♂.

O. martini (LAIDLAW). Rec. Ind. Mus. 22, 1921, p. 76 - 77. — Terra typica: Darjiling, Himalaya, ♀.

O. modiglianii SELYS. Ann. Mus. civ. Genova 2 (7) 1889, p. 471 - 472, fig. (wings ♂). — Terra typica: Nias Id., ♂ (generotype).

O. poeciloptera (KARSCH). Entom. Nachrichten, 15, 1889, p. 238 - 239. — Terra typica: Luzon P.I., ♀.

O. pryeri (MARTIN). Cat. Coll. SELYS, 19, Aeschnines, 1909, p. 134 - 135, fig. 132 (apps. ♂), pl. 2 fig. 8 (insect ♂). — Terra typica: Japan ♂.

O. venatrix (FÖRSTER). Insekten-Börse, 20, 1903, p. 2 - 3 sep. — Terra typica: Boeton Id., S. Celebes, ♂.

O. zambo NEEDHAM & GYGER. Philipp. J. Sci. 63, 1937, p. 40 - 41, pl. 2 fig. 33 - 34 (apps. ♂), pl. 3 fig. 48 (wings ♂). — Terra typica: S. Mindanao, P.I., ♂.

Apart from the N. Indian *O. martini* (LAIDLAW), and the Japanese *O. pryeri* (MARTIN), only one species of *Oligoaeschna*, viz. *modiglianii* SELYS, appears to to be well known and to have a fairly wide distribution in the Malay Archipelago. It has been reported from the island of Nias, the Mentawei Islands (Siberoet and Sipora), and Borneo; its occurrence in the Malay Peninsula and Sumatra is still a little doubtful.

The remaining species are obviously very closely related *inter se*.

O. modiglianii. — I have examined a couple of this species from Borneo in the MAC LACHLAN collection (now in the British Museum); 1 male from

Brunei (N. Borneo, ex STAUDINGER 1903) and several unidentified females, in the Leiden Museum; 5 males and 8 females, all from Borneo, in the Paris Museum; 3 males and 2 females, from Brunei or without indication of habitat, in the Brussels Museum; lastly, 3 males and 2 females, all from W. Borneo, in the Buitenzorg Museum.

O. poeciloptera and **zambo.** — Of *O. poeciloptera* (KARSCH), from Luzon, unfortunately only the female is known with certainty. This may be the same species as *O. zambo,* subsequently described by NEEDHAM & GYGER after 2 males from Mindanao. Possibly because of the male of *poeciloptera* being still unknown to science, *zambo* was compared with *bühri* (FÖRSTER) instead of with *poeciloptera. O. zambo* appears to be most closely allied to *mutata,* sp. n., but is a much larger species.

O. bühri. — Mrs. HOWARD K. GLOYD informs me that the type of this species is a single male in the Michigan Museum, Ann Arbor, labelled: Brunei, N. Borneo, Dr. O. STAUDINGER vend.

I have examined two males in the Paris Museum identified with *bühri* by MARTIN, one from "Brunnei", the other from "Borneo". The colours are faded but otherwise these examples agree in every respect with FÖRSTER's notes and with MENGER's drawing of the anal appendages of the type (MARTIN, *loc. cit.* fig. 128).

Only known from Borneo.

O. venatrix. — This species I have not seen. The male is easily distinguished from all other species of the genus by the curious fractured appearance of its superior appendages. It is only known from the island of Boeton, South Celebes.

Here follow the descriptions of two new species of *Oligoaeschna* from Borneo, and additional notes on *O. amata* (FÖRSTER).

Oligoaeschna platyura, sp. n. (fig. 16 - 17).

Material studied: — 2 ♂, 3 ♀ (ad.) 1 ♀ (juv.), E. Borneo, N. Koetai, Sangkoelirang distr., Kariorang, Pelawan Besar and Batau Besi, May-June, 1937; 1 ♂, 1 ♀ (ad.), E. Borneo, Samarinda, Dec. 1938 & March, 1939; all M. E. WALSH leg., in the Buitenzorg Museum. Holotype ♂ and allotype ♀: Pelawan Besar & Batau Besi, May 1937.

Male (ad.). — Labium orange-cinnamon, labrum tawny or ochraceous-orange, mandibles bister-coloured. Clypeus tawny-olive, sides and lower third of anterior surface of frons similarly coloured but soon becoming black from below upwards, forming a crescent-shaped black streak on top; ridge sub-acute, horizontal part of frons flattened, dark olive-brown in colour. Vertex and occipital triangle blackish-brown. Rear of the head tawny.

Synthorax velvet blackish-brown, almost black above. Dorsum with a pair of oblique, elongate-oval, green antehumeral bands, incomplete above, and with a pair of transverse, rather crescent-shaped streaks of the same colour on each side of the dorsal crest, just in front of the ante-alar triangles. On the sides

are two broad, rather diffuse, green bands, one under each wing; the anterior band occupies most of the mesepimeron and ceases at level of spiracle; the posterior band is still broader, rather rounded on both ends and covers most of the metepimeron. Between these bands, on the middle of the upper half of each metepisternite, lies a third much narrower, S-shaped or rather angular, green spot that runs parallel to the others. Infraepisternites and under surfaces brown.

Legs dark reddish-brown, apices of femora and tarsi obscured.

Wings enfumed throughout with golden brown, this forming an areola around the network of venation. Pterostigma braced, 2.2 - 2.5 mm in length, very slightly shorter in the hind wing, raw sienna (RIDGWAY), covering two underlying cells. Venation very similar to *modiglianii*, but decidedly denser; two rows of cells between M_4-*Mspl* from level of nodus to near the wing-margin in both pairs of wings. Triangles 3-celled, those of fore wings occasionally 4-celled; supratriangles with 0 - 3 crossnerves. Anal angle decidedly more pronounced than in *modiglianii* and *amata* (fig. 16). Antenodals $\frac{18-20}{12-14}$, postnodals $\frac{9-10}{12}$.

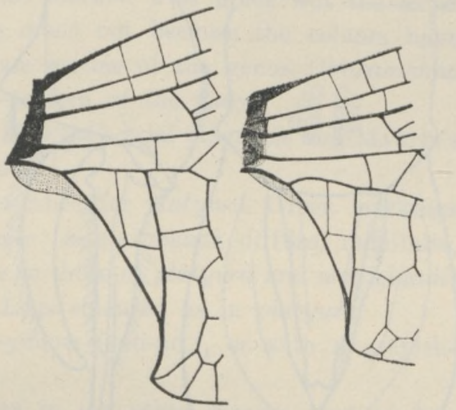


Fig. 16. Basal portion of right hind wing of *Oligoaeschna platyura*, sp. n. ♂ (left), and of *O. amata* (FÖRST.) ♂ (right).

Abdomen constricted on segment 3 (1.0 - 1.3 mm), rather strongly spindle-shaped beyond, acquiring its maximum width (2.7 - 3.2 mm) towards the end of segm. 5, from where the abdomen diminishes very gradually in width till the end of 8; 9 and 10 again very slightly broadened. Terminal segments depressed. Dark brown, basal segments paler; markings obscured (discoloured), except on basal segments of type: Segm. 1 with a green mid-dorsal mark on its distal half and a roundish lateral spot; dorsum of 2 with a basal and a terminal pair of green semi-lunar spots, interrupted in the middle line, a green point just inside the auricles and a longitudinal streak of the same colour on the posterior half of the sides. Basal two-thirds of segm. 10 dull reddish-brown, apical third blackish; basal half of segment with its dorsal surface smooth on each side of a median, longitudinal area, which is covered with numerous microscopical, transverse striae; apical half entirely, and very finely, transversely striate; the median area of this part of the segment carries in addition numerous closely set, rasp-like warts, which are crowded together on each side of a distinct longitudinal impression.

Auricles truncated apically, armed with 5 - 6 fine teeth.

Accessory genitalia not differing from those of *amata* and *modiglianii*.

Anal appendages shaped as shown in fig. 17; superior pair black, inferior appendage reddish-brown, its borders black.

Female (ad.). — Very similar to the male.

Frons olive-brown above, dirty orange-brown in front; superior margin finely obscured. Vertex and occipital triangle brown. Thoracic pattern similar to the male but all dorsal green marks a little narrower.

Legs coloured similarly to the male.

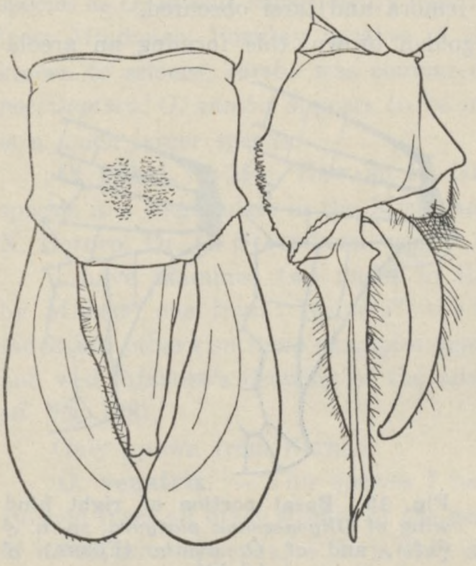


Fig. 17. *Oligoaeschna platyura*, sp. n. ♂. Anal appendages, dorsal view and right side.

Wings stained with golden yellow all over the membrane (juv.); or light golden yellow with the posterior margin of the fore wings narrowly, the anal area and the apical portion of the hind wings, from the inner end of *pt* to the end of Cu_2, broadly hyaline; bases to level of Ax_1-Ax_2 deep golden yellow (ad.); or throughout brownish yellow with only the anal area of the hind wings sub-hyaline (aged individuals). Pterostigma as in the male.

Abdomen in one specimen shaped much as in the type of *O. elacatura* (NEEDHAM) (= *modiglianii*) [1]; in the other females the abdomen is only slightly spindle-shaped (much less so than in the male) and the segments are sub-cylindrical. All markings obscured and discoloured.

Anal appendages broken off in all specimens. Dentigerous plate shaped similarly to *modiglianii*, *amata* and *mutata*.

Length: ♂ abd. + app. 47 - 50, hw. 37.6 - 40; ♀ 39.5 - 43.5, 37 - 39 mm. Holotype ♂: 49.5, 39; allotype ♀: 40.5, 39 mm.

Oligoaeschna amata (FÖRSTER) (fig. 16).

1903. FÖRSTER, Insekten-Börse, 20, p. 1 - 2 sep. — ♂ Brunei, N. Borneo (*Jagoria*).
1909. MARTIN, Cat. Coll. SELYS, 19, Aeschnines, p. 132 - 133 (pars!), fig. 129 (apps. ♂). — ♂ Borneo (*Jagoria*).

Material studied: — 3 ♂ (ad.), labelled "Brunei" or "S. Borneo", all identified "*Jagoria poeciloptera* K." by R. MARTIN, homotypes of *O. amata* (FÖRSTER), in the Paris Museum.

According to Mrs. HOWARD K. GLOYD, the types of this species (2 males from Brunei, N. Borneo, Dr. O. STAUDINGER vend.) are in the Michigan Museum, Ann Arbor.

[1]) NEEDHAM, Bull. Amer. Mus. Nat. Hist. 23, 1907, fig. 3 (insect ♀).

Without comment Martin (*loc. cit.*) identified Förster's *amata* with *poeciloptera* Karsch, the male of which is still unknown. Fortunately the sketch accompanying Martin's description of the anal appendages of the male has been made from one of Förster's type specimens; and this drawing is sufficient proof that Martin's *poeciloptera* is the true *amata* of Förster.

The specimens examined by me agree closely with the original description, except that the thorax of the male is not "einfarbig sammetbraun", but is marked dorsally with a pair of oblique green antehumeral bands, followed by a transverse streak of the same colour, on each side in front of the ante-alar triangles. The sides of the thorax are also marked with green but the exact shape of the lateral bands is not easily made out because the colours have faded from decomposition. The Malaysian species of the genus *Oligoaeschna* obviously present a very uniform colour-pattern of the body.

The following notes may be added to Förster's brief diagnosis and Martin's description of the male.

Male. — Head coloured much as described for *platyura*. Green markings on dorsum of synthorax as in that species; lateral bands diffuse, indefinite, though apparently also similar in principle to those of *platyura* and *modiglianii;* no visible pale spots on metepisternum. Legs coloured as in *platyura*.

Wings palely suffused with greyish-yellow (sub-ad.), or with a greyish-brown tinge all over the membrane (ad.).

Pterostigma greyish-brown, shaped as in the other species, that of fore wing 2.2 mm in length. Only one row of cells between M_4-*Mspl* (rarely and irregularly one double cell in one of the wings). Anal angle shaped as in *modiglianii;* membranula very narrow (fig. 16). Nodal index in one specimen $\frac{10.18.18.\ 9}{10.12.12.11}$.

Abdomen constricted on segment 3 (1.0 - 1.1 mm), slightly spindle-shaped beyond, acquiring its maximum width (2.3 mm) towards the end of segm. 4, from where it is at first parallel-sided, then diminishes very gradually in width till the end of 7; finally, 8 - 10 again somewhat broadened. Terminal segments depressed. Dark brown, markings obscured and discoloured. Segment 10 reddish-brown, smooth and shining, without any indication of transverse striae or warts (*cf.* Martin, *loc. cit.* fig. 129).

Auricles truncated apically, with 4 teeth.

Anal appendages shaped exactly as shown on fig. 129 in Martin (*loc. cit.*), reddish to blackish-brown, inferior appendage with its borders black.

Length: ♂ abd. + app. 46, hw. 37.5 mm (one specimen measured).

Female. — I have not seen this sex of *amata*, and although Martin described it in his monograph, there are neither identified nor unnamed females in the Paris Museum corresponding with this description.

Oligoaeschna mutata, sp. n. (fig. 18).

Material studied: — 1 ♂ (ad., holotype), E. Borneo, Samarinda, Jan. 1939, native collector, M. E. Walsh ded.; 2 ♀ (ad.), E. Borneo, N. Koetai,

Sangkoelirang distr., Kariorang, Jan. 2 & Febr. 21, 1937, J. W. QUARLES DE QUARLES leg. All in the Buitenzorg Museum.

Male (ad.). — Head coloured similarly to *platyura*, but dorsal surface of frons with two isolated, transverse, olive-green streaks on a reddish-brown background; or, in other words, a blackish-brown T-shaped mark on the upper surface with its stem broad, changing to reddish-brown basally and attached to a broad basal band of the same colour. Vertex and occipital triangle black. Rear of the head tawny.

Synthorax brown, blackish-brown above. Dorsum marked with green as in *platyura* and *amata*. On the sides are two broad, diffuse, green epimeral bands whose antero-dorsal limits are indistinct owing to postmortem decomposition. Apparently no metepisternal coloured spots present. Infraepisternites and under surfaces brown.

Coxae brown; trochanters and femora red-brown with the apices of the latter black; tibiae darker brown, bases and apices obscured; tarsi blackish.

Wings tinted with greyish amber; anal area of hinder pair almost hyaline, wing-tips slightly smoky. Pterostigma braced, 2.0 mm in length (fore wing), 1.9 (hind wing), tawny between black nervures.

Venation open, very similar to *modiglianii;* a single row of cells between M_4-*Mspl.* Triangles 3-celled; supratriangles with a single cross-nerve in all wings. Anal angle and membranula shaped exactly as in *amata.*

Nodal index $\frac{8.16.15.\ 9}{9.11.11.10}$.

Abdomen constricted on segment 3 (1.1 mm), not appreciably spindle-shaped beyond, acquiring its maximum width (2.3 mm) towards the middle of segm. 5, from where the abdomen diminishes but slightly and very gradually till the end. Terminal segments slightly depressed.

Black, dark brown on the sides of 1 and 2, marked with blue as follows:— A roundish spot on sides of segment 1; 2 with a triangular spot above the auricles, a minute triangular basal mid-dorsal spot, a pair of trapezoidal transverse dorsal spots at the jugal suture and a pair of closely approximated apical lunules of the same size as the jugal spots; segm. 3 - 6 each with similar, though smaller, jugal and apical spots, the former progressively smaller from before backwards and vestigial on 6, the latter in the form of narrow, transverse, dorso-lateral rings, finely constricted in the middle on 3 - 5, entire on 6; segm. 7 only with a narrow apical transverse streak, and 8 with a pair of apical annules; remaining segments unmarked, black. Segm. 10 dull, the entire dorsum and most of the sides very closely, microscopically, transversely striate; mid-dorsally, this segment carries in addition a number of scantily distributed rasp-like denticles, which are more or less definitely arranged in rows, whilst there is no longitudinal impression.

Auricles truncated apically, armed with 4 - 5 teeth.

Accessory genitalia not different from those of the allied species.

Anal appendages shaped as shown in fig. 18; superior pair black, inferior appendage dark reddish-brown, its borders and apex black.

Female (ad.). — Very similar to the male, but for the following differences:—

Head with the green frontal streaks distinct, though less sharply defined, and with the upper surface of the frons uniform brown, only the frontal crest being slightly obscured.

Synthorax uniform reddish-brown; green dorsal marks closely resembling those of the male, but lateral bands ill-limited and pale bluish instead of green.

Fore wings diffusely tinted with yellowish from the pterostigma nearly to level of arculus and beyond that level in the costal and cubital spaces; hind wings palely and diffusely amber tinted but with the anal area and the apices, from distal side of *pt* backwards to the point where Cu_1 meets the wing-margin, hyaline. Pterostigma ochreous-brown.

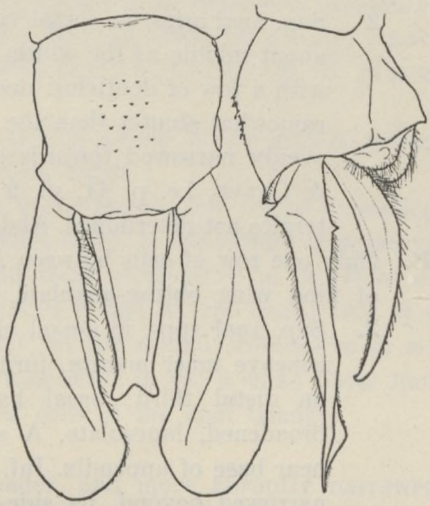


Fig. 18. *Oligoaeschna mutata*, sp. n. ♂. Anal appendages, dorsal view and right side.

Abdomen spindle-shaped, contricted on segment 3, thence widened (greatest width over the middle of 5), finally again narrowed, with cylindrical segments. The two basal segments are brown, the remainder black. Pale markings definitely green, closely similar to male, only the lateral marks of segment 1 and 2 greatly enlarged, that on 2 in the form of a complete stripe running from base to apex of segment, parallel to the lower border of the tergite.

Anal appendages broken off in both females. Dentigerous plate shaped exactly as in the allied species.

Length: ♂ abd. + app. 42.5, hw. 34; ♀ (allotype) 38, 35; ♀ (paratype) 35, 33.5 mm.

Key to some species of *Oligoaeschna*.

The following key may serve to distinguish the males of five species of *Oligoaeschna*, viz. *O. amata, bühri, mutata, platyura,* and *zambo,* which form a group of closely allied species.

1. Two rows of cells between M_4-*Mspl* in both pairs of wings. Anal angle of hind wing sharply pronounced, acute-angulate, inner border slightly emarginate (fig. 16). (Shape not determined in *zambo*).
   2. Sup. anal apps. in dorsal view very broadly lamellar, more than twice as broad about middle as the width at base, armed on the intero-ventral margin with a strong basal tooth, followed successively by 2 - 3 very

small ones and a larger, obtuse-angulate projection before the middle of their length (the small teeth invisible in profile view). Inf. app. in dorsal view narrowly triangular, its side-margins straight, apex very slightly and narrowly bifid, the end-lobes not divergent nor produced laterad (fig. 17). Sculpture of 10th abdominal tergite, see description. Abd. 47 - 50, hw. 37.6 - 40 mm. Hab.: Borneo. .... *platyura*

2'. Sup. anal apps. in dorsal view much narrower, less than twice as broad about middle as the width at base, armed on the intero-ventral margin with a row of denticles: one sub-basal tooth, visible in profile view and somewhat stouter than the rest. Inf. app. shaped much as in *platyura*, evenly narrowed towards apex, which is but little excised (NEEDHAM & GYGER, l.c. p. 41, pl. 2 fig. 33 - 34). Sculpture of 10th abdominal tergite not determined. Abd. 49, hw. 38 mm. Hab.: Mindanao. .. *zambo*

1'. Only one row of cells between M_4-*Mspl* in both pairs of wings. Anal angle of hind wing obtuse-angulate, inner border straight (fig. 16).

2. Sup. anal apps. in dorsal view narrow, gently incurvate with distinctly concave inner margin, furnished with numerous black hairs especially on distal third; basal half of each parallel-sided, apices a little broadened, lanceolate. A single strong intero-ventral tooth, situated near base of appendix. Inf. app. in dorsal view broad at base, strongly narrowed beyond, its side-margins concave, apex broadened, slightly and narrowly bifid, the end lobes distinctly produced laterad (MARTIN, l.c. p. 132 fig. 128). Dorsum of 10th abdominal segment covered with numerous microscopical teeth. Abd. 44, hw. 35 mm. Hab.: Borneo. *bühri*

2'. Sup. anal apps. in dorsal view evenly widened from base distalwards, broadly lamellar, almost twice as broad about middle as the width at base.

3. Dorsum of 10th abdominal segment entirely smooth and shining. Sup. anal apps. with the inner margin at first slightly concave, thence a little convex, apices evenly narrowed and bluntly pointed. A single strong intero-ventral tooth, situated near base, followed by a much smaller denticle (invisible in profile view) at about one quarter of the length of appendix. Inf. app. slenderer than in *amata*, in dorsal view at first somewhat narrowed, its side-margins slightly concave, apex broadened, strongly bifid, the end-lobes distinctly produced laterad (MARTIN, l.c. p. 133, fig. 129). Abd. 45 - 46, hw. 36 - 37.5. Hab.: Borneo. .... *amata*

3'. Dorsum of 10th abdominal segment, see description. Sup. anal apps. in dorsal view with the inner margin almost straight, apices cut off obliquely, rounded. Intero-ventral margin armed with one rather small sub-basal tooth followed by two irregular, small denticles, which are invisible in profile view. Inf. app. in dorsal view broad at base, evenly narrowed beyond, its side-margins straight,

apex slightly broadened, strongly bifid, the end-lobes distinctly produced laterad, but less so than in *amata* (fig. 18). Abd. 42.5, hw. 34 mm. Hab.: Borneo. .... *mutata*

Amphiaeschna ampla basitincta, subsp. n.

Material studied: — 1 ♂, 1 ♀ (ad.), S.W. Sumatra, Benkoelen residency, Tandjong Sakti near Pageralam, 600 m alt., May 27, 1935 (♂, holotype), Moeara Tenam, 250 m alt., June 16 - 23, 1935 (♀, allotype), M. E. WALSH leg., in the Buitenzorg Museum.

Both sexes differ very strikingly from typical *ampla* in the greater extent of the brown basal patch to the fore and hind wings.

Male (ad.). — Base of fore wing dark burnt-brown, this colour extending to as far as Ax_2 in *c;* to half-way between Ax_{2-3} in *sc;* to the second cross-nerve in *m;* and to half-way between second and third cross-nerve in *cu.* Base of hind wing similarly coloured to as fas as Ax_1 in *c* and *sc* (the costal half of *c* hyaline; basal antenodals in *sc* not counted); to the second cross-nerve in *m;* and to half-way between first and second cross-nerve in *cu;* a small basal spot of the same colour in each of the two basal cells of the anal triangle.

Body-colours faded.

Superior anal appendages a trifle broader, and more abruptly narrowed apically, than in *ampla ampla,* the distal half of each slightly outbent; otherwise identical with the typical race (e.g., *ampla,* length to breadth 6.8: 1.2; *basitincta,* 6.6: 1.5 mm).

Wing-bases marked with dark brown similarly, though slightly less extensively, as in the female of typical *ampla* from Java.

Female (ad.). — Body-colouring dark reddish brown; all yellow and green markings faded and unapparent.

Wings hyaline, anterior pair with a large, diffuse patch of pale brown in the area between nodus and pterostigma, broad at the costa, narrowing towards and not quite reaching the hinder border of wing; this patch very similar to typical *ampla* but more extensive and decidedly deeper in tint. There is, in addition, a small brown nodal spot in both pairs of wings filling up part of the costal cell between nodus and Px_1. Basal patch dark burnt-brown, paler distally; cell-middles of *c* and *m* paler brown. In fore wing it extends diffusely as far out as Ax_{6-7} in *c* and *sc;* to the arculus in *m;* to almost as far as *ti* in *cu;* and from there in a curve to the posterior border of the wing, filling up almost the basal half of the anal area. In the hind wing the basal patch is more sharply limited, extending to beyond level of arculus in *c* and *sc* (Ax_{8-9} in *sc*); than abruptly back to the arculus in *m,* to the proximal side of *ti* in *cu,* and from there in line with this nervure to the border of the wing.

Genital plate (dentigerous plate) identical in shape to that of typical *ampla* [1]), finely denticulate.

[1]) See F. C. FRASER, Treubia, 8, 1926, p. 474, fig. 2 (nec 3!).

Anal appendages also very similar, though comparatively less slender, and with the mid-rib broader (e.g., *ampla*, length to breadth 7.3: 1.5; *basitincta*, 7.0: 1.7 mm).

Length: ♂ abd. 54 + 6.6, hw. 54, pt. $\frac{3.2}{3.0}$; ♀ 52 + 7, 55, $\frac{3.2}{3.0}$ mm.

Up to the present in Sumatra the well known Javan species *Amphiaeschna ampla* has not been observed. In Java *ampla* is a moderately common species in wooded districts, inhabiting low country up to about 800 metres above sea-level. It is strictly nocturnal in habits and therefore seldom seen on the wing. The discovery of a subspecies of *ampla* in Sumatra means a welcome addition to our knowledge of its distribution.

The extent of the blackish-brown basal patch of the wings of typical *ampla* is remarkably constant in a series of 38 males and 22 females examined, from various localities scattered all over the island of Java.

MARTIN in his monograph gives excellent wing-photographs of both sexes of typical *ampla* from Java [1]), which may conveniently be consulted in comparison with the above description of *A. a. basitincta.*

Heliaeschna bartelsi, sp. n.

1909. MARTIN, Cat. Coll. SELYS, fasc. 20, Aeschnines, p. 161 - 162, fig. 162 (apps. ♂). — ♂♀ Borneo; "Cooktown" (error). (*simplicia*).

1911. MARTIN, Genera Insect. WYTSMAN, fasc. 115, p. 26, pl. 6 fig. 1 (col. fig. ♂), 1a-b (apps. ♂) (*simplicia*).

Material studied: — 1 ♂ (ad.), labelled: "Borneo, W.K." (SELYS, yellow), "*Heliaeschna simplicia* Karsch ♂ Borneo" (SELYS, white); 1 ♂ (juv., apps. lacking), "Borneo W.K."; 2 ♀, "Borneo, W.K.", one identified with "*Heliaeschna simplicia* Karsch ♀ Borneo" (SELYS, white); all in the Brussels Museum. — 2 ♂ (ad.), S. Sumatra, Lampong Res.: Menggala, Terbanggihilir, low country, Aug. 16 - 20, 1936, MAX BARTELS leg., in the Buitenzorg Museum. — 4 ♂, 4 ♀ (juv.-ad.), W. Borneo, Singkawang distr., near Bakoean, Febr. 18, 1932 and Jan. 22, 1933 (1 ♂, 2 ♀ juv.); Jan. 22 and April 9 - 10, 1934 (3 ♂, 2 ♀ ad.), L. COOMANS DE RUITER leg., in the Buitenzorg Museum.

Holotype ♂ and allotype ♀: W. Borneo, Bakoean, April 9-10, 1934.

Male (ad.). — Mouth-parts ochraceous-orange, usually discoloured to cinnamon; labrum in one example with distinct greenish intermingling. Clypeus and frons ecru-olive (RIDGWAY), fading to olive-ocher laterally and over the sutures. Frontal ridge acute, obtuse-angulate and $\wedge$-shaped in dorsal view, the ridge itself pale-coloured. Dorsal surface of frons and vertex finely rugosely punctured, brownish-olive in colour. Occipital triangle dark brown. Antennae brown. Eyes dark greenish-blue. Rear of the head cinnamon-buff.

Synthorax short and small. Dorsum, to almost as far laterally as the humeral suture, lumière blue (RIDGWAY), including the ante-alar triangles; this

[1]) R. MARTIN, Cat. Coll. SELYS, fasc. 19, 1909, Aeschnines, p. 113 fig. 106 (♂), p. 114 fig. 107 (♀, sub *perampla*).

colour changing into a delicate turtle- or malachite green, laterally. Dorsum and sides unmarked save for the mid-dorsal carina, the borders of the ante-alar triangles, and the upper margin of the pleurae, which are brown. Under surfaces and coxae pale brownish or flesh-coloured; metasternum slightly pruinose. Nota and axillaries lumière blue.

Legs dark purplish-brown to almost black; inner surfaces of femora, distal third of tibiae, and all tarsi, diffusely cinnamon-rufous.

Wings very long, with the basal half rather narrow, the apical part gradually diminishing in width towards the apices, which are evenly and bluntly rounded; greatest breadth of hind wing before the nodus. Membrane strongly tinted throughout, usually deeply and evenly enfumed, save for the extreme bases, which are hyaline. Venation moderately dense, brown. Primary antenodals the first and ninth or tenth. A basal postcostal nervure invariably present in all wings. *Arc* situated mid-way between the two primary antenodals. *t* elongate, made up of 6 - 7 cells, distal side sinuous; basal angle situated distal to level of *Arc* for a distance about half as long as proximal side. *ht* traversed by 4 - 7 cross-nerves in fore wing, 5 - 6 in the hind (4.5 in fore wing of type). Basal part of hind wing rather narrow, base obtuse-angulate; tornus in line with distal side of anal triangle obtuse-angulate. Anal triangle three-celled, its costal side exceptionally long, scarcely less than three-fourths as long as distal side. Membranula vestigial, whitish. Anal loop oval, made up of 8 - 10 cells. Antenodals $\frac{22-26}{18-20}$, postnodals $\frac{13-15}{15-18}$ ($\frac{13.23\ 23.14}{18.19.19.15}$ in the holotype). Cubital space (including *ti*) traversed by 10 - 11 cross-nerves in fore wing, 8 - 9 in the hind; *m* with 5 - 7 cross-nerves in fore wing, 4 - 6 in the hind wing ($\frac{7.5}{5\ 6}$ in the type). *Rs* forked a little distal to or at the level of the proximal side of *pt* in fore wing, slightly proximal to or at that level in hind wing. (In one teneral male from Borneo *Rs* forks decidedly beyond level of proximal side of *pt* in both pairs of wings). Fork narrow, with only two rows between its branches and with three marginal cells. 5 - 6 rows of cells between *Rs-Rspl* at the point of greatest divergence; 1 row of cells between M_3-M_4 in both pairs of wings (usually 1 - 2 doubled cells about the middle of their course); 1 row of cells between Cu_1-Cu_2 in hind wing; all wings with 3 - 4 rows of cells in the intervening space between M_4-*Mspl* where most widely separated. Pterostigma usually lacking a distinct brace-vein; in most individuals, however, a brace is accidentally present, at least so in one or two of the wings; *pt* long, brownish-yellow in colour, covering 3 - 4 underlying cells.

Abdomen of peculiar shape: basal segments cylindrical, very slightly tumid; segment 3 not constricted or only to the slightest extent; beyond the constriction the abdomen broadens very little, acquiring its maximum width towards end of segm. 4, from where the abdomen tapers again very slightly as fas as the end.

Auricles exceptionally small (hardly 0.5 mm in length), armed with 3 minute apical teeth. Abdomen dark purplish- to blackish-brown with rich blue and green markings, as follows:—

Segment 1 with most of the sides blue-green and with a transverse light blue spot, occupying the apical half of the dorsum. Segm. 2 with bright blue-green AML and PL, occupying most of the sides; AD small, blue in colour; MD narrow, paired and likewise blue; PD large, paired, finely separated in the middle line, each of the spots trapezoidal, bright blue in colour. Segm. 3 with AL and ML blue, narrowly separated by the transverse carina; MD linear, blue, confluent with ML laterally; PD isolated, united mid-dorsally, forming a large semicircular blue spot, occupying about $^1/_5$ of the whole length of segment. Segm. 4 - 8 with AL and ML rather narrow and in the form of marginal bluish streaks decreasing in size posteriorly; MD distinct, progressively more pointed cauded from before backwards; PD isolated, dark blue in colour, forming a conspicuous semicircular dorsal spot, which is finely divided by the longitidunal carina and about one-third as long as the posterior division of the segment on 4 - 6, one-fourth on 7, and in the form of paired spots on 8 and 9. Segm. 10 reddish-brown, its posterior border black. Ventral surface of abdominal segments brown.

Anal appendages: superior pair brown, their borders blackish-brown fringed with dark brown hairs interiorly; inferior appendage dark brown. Sup. anal apps. shaped exactly as shown on fig. 162 of MARTIN's monograph (*loc. cit.*, p. 161); inf app. short, triangular, deeply channelled, apex with a narrow V-shaped incision, the tips acute and strongly upturned.

Female (ad.). — Resembles the male almost in all but sexual characters. Synthorax uniform dark greyish-brown with the slightest indication of some greyish-blue colouring on the middle of each mesepisternite. Nota and axillaries chrome-yellow, intermingled with green.

Legs reddish-brown, apices of anterior femora obscured.

Wings shaped as in the opposite sex. Membrane evenly tinged with yellow save for the extreme bases, which are hyaline (juv.), or deeply and evenly enfumed, especially towards the apices, the bases being hyaline or only palely tinted (ad.). Venational details very similar to male. Pterostigma long, pale ochreous, covering 3 - 4 cells.

Abdomen shaped much as in the opposite sex: widest at end of first segment, tapering to the end of segm. 7; base of 8 slightly constricted, but apically acquiring a little over the width of 7, then again slightly tapering to the end of abdomen. Coloration dark brown, basal segments intermingled with diffuse olive-grey; tergal margins and under surfaces light brown. Markings similar in principle to the male, but very indistinct or obscured and decidedly smaller, especially PD, which is all but invisible on segments 6 - 9. Terminal segments apparently unmarked.

Ovipositor extending to about half-way the length of segm. 10. Dentigerous plate produced, trapezoidal in shape and rather swollen; laterally furnished with short bristles and, apically, occasionally with some microscopical teeth, on each side just before the origin of the spines; spines two in number, much shorter than in *Gynacantha*, but hardly shorter than the plate, divaricate, evenly

and slightly downcurved apically. Shape of anal appendages unknown (fractured off in all specimens so far taken); basal portion (about 2 mm in length) extremely narrow, gently decreasing in width apically.

Length: ♂ abd. + app. 49 - 50.5, hw. 45.7 - 47, pt. $\frac{3.9\ \ 4.3}{3.8-4.0}$; ♀ abd. 48.5 - 50.5, 51.5 - 53, pt. $\frac{4.0-4\,5}{3.7-4.3}$ mm.

The two Sumatran specimens do not differ in any way from our series of Borneo.

This very distinct species has no near allies. The male superficially resembles a small *Tetracanthagyna*. Both sexes are easily distinguished from all other Asiatic *Heliaeschnae* by the long and narrow wings, and by the very narrow fork of *Rs*, which has only two rows of cells between its branches whilst there are only three marginal cells. The pterostigma is decidedly longer and the apices of the wings are much more rounded off than in such species as *simplicia* (KARSCH) and its 'double', *vanderweelei* MARTIN. Neither the male nor the female show any narrowing of the abdomen at the third segment, whereas in the species just mentioned this segment in the male is strongly constricted basally, and at least slightly so in the female. The simple structure of the anal appendages of the male and the t w o - pronged dentigerous plate of the female may further serve to the easy recognition of *bartelsi*.

H. bartelsi has long been mistaken for *H. simplicia* (KARSCH), described also from Borneo, and until recently I thought it to be that species, following MARTIN's account in the monograph.

Now that I have examined KARSCH's type of *simplicia* in the Berlin Museum, it is quite evident that the latter is entirely different from *bartelsi*, agreeing most closely with MARTIN's species *vanderweelei*, which was erroneously described from "Liberia" [1]). I have compared the types of *simplicia* with a fine series of both sexes (from West Borneo) in the Buitenzorg Museum and found them agreeing in every respect. Not only is there a close similarity between the anal appendages and the dentigerous plates of *simplicia* and *vanderweelei*, but there is also a great resemblance in the venation, body-colouring and size. At the moment I can find no differences between them and I doubt if *vanderweelei* can be regarded as a valid species.

In the Berlin Museum is a male of this species from Palembang (E. Sumatra), identified with *vanderweelei* by Dr. E. SCHMIDT. The species *H. "vanderweelei"* is also represented in our collection by a good series of males and females, collected in the residencies of Palembang and Djambi, in East Sumatra.

FÖRSTER [2]) has proposed to create a distinct genus for the Asiatic species of the genus with the name *Malayaeschna* (generotype: *Amphiaeschna simplicia* KARSCH).

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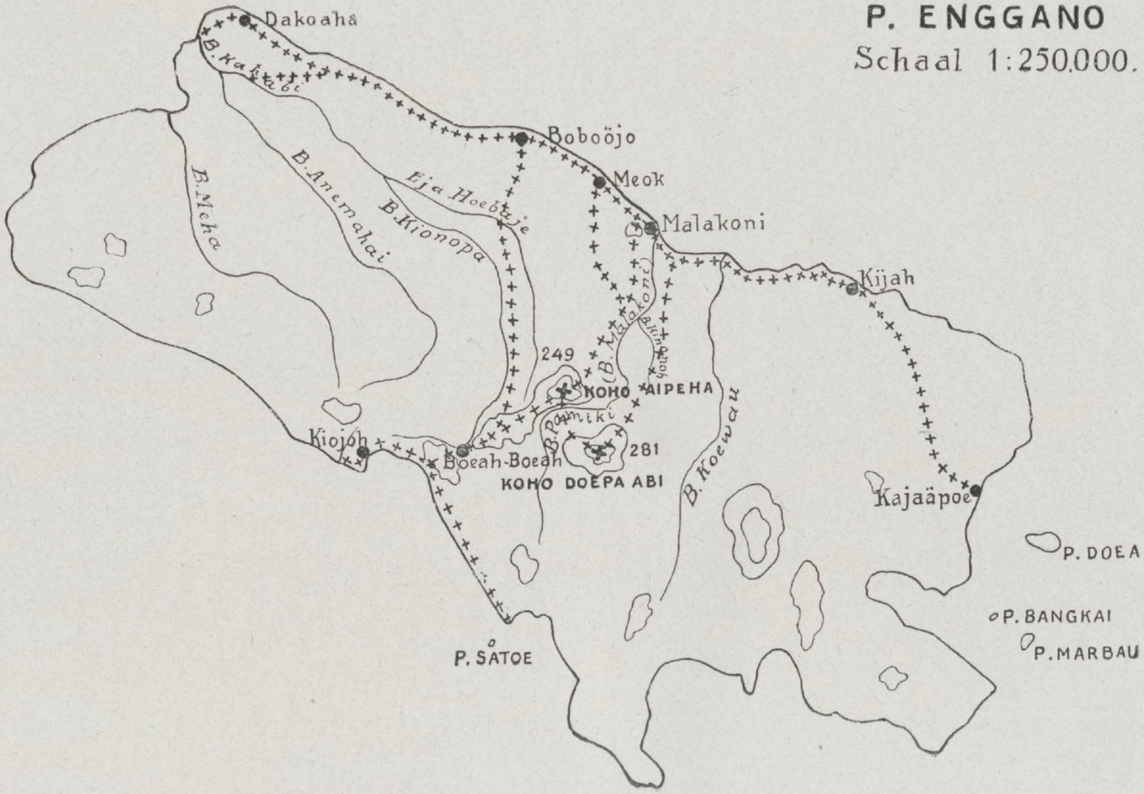
[1]) See RIS, Zool. Meded. Leiden, 10, 1927, p. 31 - 33, fig. 22 (apps. ♂), 23 (genit. ♀).
[2]) FÖRSTER, Jahrb. Nassau. Ver. Naturk. Wiesbaden, 62, 1909, p. 219.

His reasons are that the latter have a longer *t* and wings more pointed relatively than the African species; and that whilst *Malayaeschna* has a four- or six-toothed dentigerous plate, the African *Heliaeschnae* have a two-pronged plate. It is worth remark that the dentigerous plate of the female of *H. uninervulata* MARTIN is armed with t h r e e spines, and that the new Asiatic *H. bartelsi* approaches the Ethiopean group in the simple structure of the male superior appendages and the two-pronged genital plate of the female. For these reasons alone it does not seem advisable to accept FÖRSTER's name *Malayaeschna*.



P. ENGGANO
Schaal 1:250.000.
Dakoaha
B. Kahabi
Boboöjo
Meok
Malakoni
Kijah
B. Meha
B. Anemahai
B. Kionopa
Eja Hoeboäje
(B. Malakoni)
249
KOHO AIPEHA
B. Pamiki
281
KOHO DOEPA ABI
B. Koewau
Kiojoh
Boeah-Boeah
Kajaäpoe
P. DOEA
P. BANGKAI
P. MARBAU
P. SATOE

ON THE MAMMALS OF ENGGANO

by

H. J. V. SODY

(Buitenzorg, Java).

The small but well prepared collection of mammals, in 1936 made on this island by Dr. J. K. DE JONG, and placed in my hands for determination by the Director of the Buitenzorg Zoological Museum, consists of 44 specimens which represent the following 9 species and subspecies, three of which had to be provided with new names.

(The external measurements have always been taken by the collector).

1. **Rousettus amplexicaudatus** (GEOFFROY) subsp.

Pteropus amplexicaudatus, GEOFFROY, Ann. Mus. Hist. Nat., XV, 1810, p. 96 (Timor).
Xantharpyia amplexicaudata, THOMAS, Ann. Mus. Civ. Genova, XXXIV, 1894, p. 108; VAN BALEN, De Dierenw. v. Insul., I, 1914, p. 110.
Rousettus amplexicaudatus, WILLINK, Natuurk. Tijdschr. Ned. Ind., LXV, 1905, p. 275; MILLER, Proc. U. S. Nat. Mus., XXX, 1906, p. 824; ANDERSEN, Cat. Chir. Br. Mus., I, 1912, p. 40, 48.
Rousettus amplexicaudatus amplexicaudatus, ANDERSEN, Cat. Chir. Br. Mus., I, 1912, p. 812, 829.

2 ♂, 1 ♀.

It is impossible for me to determine the subspecies here. The two races which need consideration, *amplexicaudatus* and *minor*, very much overlap in their measurements and the Enggano specimens are intermediate. Indeed also geographically the division, as given by ANDERSEN, is but little satisfying. To *amplexicaudatus* he reckons animals from Cambodja, Philippines, Borneo, Sumatra, Enggano, Flores, Savoe, Alor and Timor (from the last named locality — the type locality — he only had one immature specimen, from Enggano nothing at all), the name *minor* is restricted to Java. It is certain that he Javanese average smaller than the Timorese of which now a fine series of 8 specimens could be measured.

Measurements of the Enggano series:

Number	Sex	Head & body	Tail	Foot	Ear	Forearm	Skull: great. length	Teeth $c - m^2$	Teeth $p^3 - m^2$
305/36	♂	122	16	17	17	81	37.6	12.5	9.4
307/36	♂	112	17	17	17	76	—	12.7	9.5
306/36	♀	120	17	17	18	81	35.3	12.7	9.4

Comparison with examples from Timor (*amplexicaudatus*) and Java (*minor*):

	Forearms	Teeth, c-m^2	Teeth, p^3-m^2
Timor	77 - 80.6 - 84 (8)	12.4 - 12.74 - 13.1 (8)	9.3 - 9.56 - 10.0 (8)
Enggano	76 - 79.3 - 81 (3)	12.5 - 12.63 - 12.7 (3)	9.4 - 9.43 - 9.5 (3)
Java	70 - 76.5 - 81.5 (90)	12.0 - 12.66 - 13.3 (15)	9.0 - 9.40 - 9.8 (2)

I am not able to say more than that the Enggano specimens are roughly intermediate between *amplexicaudatus* and *minor*. Also comparison with specimens from other localities did not bring any elucidation.

2. Pteropus hypomelanus enganus MILLER.

Pteropus enganus, MILLER, Proc. U. S. Nat. Mus., XXX, 1906, p. 822, 824 (Pulo Dua, off Enggano).

Pteropus hypomelanus, THOMAS, Ann. Mus. Civ. Genova, XXXIV, 1894, p. 106; TROUESSART, Cat. Mamm., I, 1897, p. 82; WILLINK, Natuurk. Tijdschr. Ned. Ind., LXV, 1905, p. 274.

Pteropus (Spectrum) hypomelanus, MATSCHIE, Megachir., 1899, p. 24.

Pteropus hypomelanus enganus, ANDERSEN, Cat. Chir. Br. Mus., I, 1912, p. 107, 111; CHASEN & KLOSS, Proc. Zool. Soc., 1927, p. 833.

6 ♂, 3 ♀.

Measurements:

Number	Sex	Head & body	Foot	Ear	Forearm	Skull: great. length	Zygomatic breadth	Teeth, c-m^2	Teeth, p^3-m^2
231/36	♂	210	41	25	143	63.5	35.5	23.8	16.3
222/36	♂	179	40	23	(135)	63.8	34.3	22.9	16.2
217/36	♂	215	41	24	129	64.6	34.9	23.9	16.1
232/36	♂	203	40	24	140	63.9	33.3	24.0	17.0
208/36	♂	172	40	25	121	54.6	26.9	20.4	15.3
227/36	♂	212	41	26	131	62.3	34.5	22.5	16.0
215/36	♀	205	41	23	129	61.4	32.5	22.9	15.9
223/36	♀	162	36	21	(124)	59.5	30.7	22.0	15.4
216/36	♀, juv.	145	35	21	102	46.8	24.6	—	—

The form has been described as averaging smaller than any other race of the species. Now in the present series the forearms seem too large to warrent this conclusion. The teeth measurements, however, furnish an excellent confirmation.

All specimens show light-coloured heads except No. 208 and especially No. 216. The p^1 is present at one side in Nos. 217 and 215, at both sides in Nos. 208 and 216.

3. **Pteropus modiglianii** THOS.

Pteropus modiglianii, THOMAS, Ann. Mus. Civ. Genova, XXXIV, 1884, p. 106 (Kifajuc, Bua-Bua, Enggano).

Pteropus modiglianii, TROUESSART, Cat. Mamm., I, 1897, p. 81; Miller, Proc. U.S. Nat. Mus., XXX, 1906, p. 823; MILLER, Fam & Gen. of Bats, 1907, p. 56, 58; ANDERSEN, Cat. Chir. Br. Mus., I, 1912, p. 232, 235.

Pteropus nicobaricus a. *modiglianii*, MATSCHIE, Megachir., 1899, p. 17; TROUESSART, Cat. Mamm., Suppl., 1904, p. 50; WILLINK, Natuurk. Tijdschr. Ned. Ind., LXV, 1905, p. 275.

Pteropus melanotus, RENSCH, Die Gesch. d. Sundabogens, 1936, p. 72.

7 ♂.

Measurements:

Number	Sex	Head & body	Foot	Ear	Forearm	Skull: great. length	Zygomatic breadth	Teeth, c-m²	Teeth, p³-m²
212/36	♂	223	42	29	145	62.1	36.7	24.3	17.9
211/36	♂	222	41	28	143	63.1	36.7	24.2	17.5
230/36	♂	230	43	28	150	64.3	36 0	25.3	18.4
221/36	♂	184	41	24	(139)	64.3	35.8	24.3	17.3
213/36	♂	223	42	30	152	61.2	36.3	24.6	17.4
210/36	♂	206	41	28	136	65.1	35.2	25.0	17.9
209/36	♂	177	42	27	122	± 57	29.6	22.8	16.7

The p^1 is present at one side in No. 211, at both sides in No. 209.

DE JONG (Natuurk. Tijdschr. Ned. Ind., XCVIII, 1938, p. 36) describes the way in which on Enggano k a l o n g s take the place of squirrels in gnawing a round hole in the still soft skin of young coconuts to eat the young fruit flesh.

4. **Cynopterus brachyotis concolor** subsp. n.

3 ♂, 2 ♀.

Type: ♂ ad., Meok, Enggano, sea-level, coll. SAÄN, 27 June 1936. In Buitenzorg Museum, No. 225/36.

Diagnosis: Size about as in *brachyotis* of Borneo, but very well distinguished by the colour, especially darker and without the handsome rufous or russet which is shown so finely by old males and even old females of *brachyotis* and *javanicus*. Moreover it is very striking that there is no lightening of the skin covering the finger bones, in which respect the form agrees with *babi* LYON of Pulo Babi. From this, in colour closely resembling form, our race is geographically separated by the very small *minutus* of Nias, while also the large Pagi (Pagai) form (*pagensis* MILLER, according to ANDERSEN, however, = *angulatus*) clearly shows the light fingers. Moreover, *babi* is larger (greatest length of the skull 30.0; c-m^1 10.2 mm).

Measurements:

Number	Sex	Head & body	Tail	Foot	Ear	Forearm	Skull: great. length	Teeth, C-m[1]	Teeth, p[4]-m[1]
314/36	♂	92	9	14	15	63	29.1	9.5	6.6
313/36	♂	98	9	12	16	64	—	9.7	6.8
225/36	♂	100	14	15	16	65	29.0	9.3	6.6
312/36	♀	99	8	13	15	63	28.8	9.3	6.7
226/36	♀	101	11	15	16	66	29.4	9.3	6.3

Some more measurements of the type: 3rd. metacarpal 41.3; skull: condylobasal length 28.1; basal length 26.0; zygomatic breadth 19.1; cranial width 12.2; interorbital constriction 6.8; postorbital processes, tip to tip, 10.9; lower teeth, c-m_2, 10.4 mm.

(It seems good to fix special attention to this striking conformity between P. Babi and P. Enggano, the more so as there exists another case which seems to point to the same direction. It is POCOCK's conception of uniting the Simaloer and Enggano specimens of *Paradoxurus hermaphroditus* into the race *parvus*, while at the same time he takes together the animals of the Mentawei Archipelago and of N. Pagai under *lignicolor*).

5. Hipposideros diadema masoni (DOBS.).

Phyllorhina masoni, DOBSON, Journ. As. Soc. Beng., XLI, 1872, p. 338 (Moulmein, Tenasserim).

Hipposideros diadema, THOMAS, Ann. Mus. Civ. Genova, XXXIV, 1894, p. 108; WILLINK, Natuurk. Tijdschr. Ned. Ind., LXV, 1905, p. 281; MILLER, Proc. U. S. Nat. Mus., XXX, 1906, p. 824; VAN BALEN, De Dierenw. v. Insul., I, 1914, p. 126.

Hipposideros diadema enganus, ANDERSEN, Ann. Mus. Civ. Genova, XLIII, 1907, p. 8.

2 ♂, 4 ♀.

Partly the 7 new races, added by ANDERSEN to the existing number of 3, seem founded on extremely weak argument. Personally I have no objections against separating races on differences in averages of the measurements only, but then, of course, sufficiently large series should be available and, by preference, the average of the one series should lie beyond the limits of the other. In reality ANDERSEN distinguished all his 10 races in a total series of about 40 specimens (in which one series of 7 and one of 8). So he established DOBSON's *masoni* as a good subspecies after 2 specimens, with the remark that *masoni* (Malay Peninsula) and *diadema* (Timor and Java) "can only be distinguished by average characters", and immediately after he separates *enganus* from *masoni*, again after 2 specimens, with the remark that he has "no doubt that in a large series of the Enggano form individuals will be found which are practically indistinguishable from *masoni* and *diadema*".

I am now in a position to compare the measurements of the 6 Enggano specimens from the collection DE JONG with those of 12 specimens from Java and more easterly islands.

Measurements of the Enggano series:

Number	Sex	Head & body	Tail	Foot	Ear	Forearm	Skull. great. length	Ante-orbital width	Teeth c - m^2
218/36	♂	101	48	16	31	90	35.5	10.2	13.0
220/36	♂	100	52	15	31	87	33.9	9.8	12.2
309/36	♀	92	48	15	30	86	—	9.5	11.9
310/36	♀	90	54	16	30	84	33.5	9.8	12.0
311/36	♀	90	50	15	29	84	33.5	9.9	12.2
308/36	♀	91	51	16	28	87	33.2	9.7	12.0

Comparison of these measurements (increased with the two Enggano measurements of ANDERSEN for forearm and anteorbital width, but not with those of the teeth, as I suppose that he did not use the same — alveolar — measurement as I did) with examples from Malaya and from Java gives:

	Forearm		Anteorbital width		Toothrow, c-m^2, alv.	
masoni	85 - 87.5 - 90.5	(3)	9.8 - 9.90 - 10.0	(2)	— — —	—
"*enganus*"	84 - 87.6 - 93	(8)	9.5 - 9.87 - 10.2	(7)	11.9 - 12.22 - 13.0	(6)
diadema	85 - 88.3 - 93	(12)	9.0 - 9.37 - 9.9	(10)	11.5 - 11.92 - 12.8	(12)

It is the difference in the anteorbital width which leads me to acknowledge a separation between *diadema* and *masoni* + *enganus*. Between *masoni* and *enganus*, however, no difference is known to me, nor can I conclude to such a difference from ANDERSEN's description.

6. Rattus rattus diardi (JENT.).

Mus diardi, JENTINK, Notes Leyden Mus., II, 1880, p. 13 (W. Java).

1 ♂, Poeloe Doea (No. 229/36).

Measurements: Head and body 156; tail 159; hind foot 29 (certainly too small); ear 20; skull: greatest length 38.2; condylobasal length 36.9; basal length 34.7; palatal length 21.3; zygomatic breadth 17.7; cranial width 14.6; interorbital constriction 4.9; length of nasals 13.2; breadth of combined nasals 3.8; diastema 10.3; incisive foramina 7.8; upper toothrow 6.9 mm.

These measurements and the colour sufficiently justify a determination to *R. r. diardi*, to which race I also reckon the houserats of Java, Bali, Lombok, Banka, Sumatra, Sipora and Malaya.

7. Rattus rattus vernalus subsp. n.

?*Mus rattus* var., THOMAS, Ann. Mus. Civ. Genova, XXXIV, 1894, p. 109.
?*Mus* near *rattus*, MILLER, Proc. U. S. Nat. Mus., XXX, 1906, p. 821.
Rattus rattus, DE JONG, Natuurk. Tijdschr. Ned. Ind., XCVIII, 1938, p. 35.

2 ♂, 4 ♀.

Type: ♀ ad., Kajaäpoe, Enggano, sea-level, coll. Dr. J. K. DE JONG, July 1936. In Buitenzorg Museum, No. 316/36. Skull badly damaged.

Diagnosis: While in some parts of the Archipelago *R. rattus* seems rather overnamed, as regards the islands west of Sumatra only a few races of this so variable species have been described. And these races (*mentawi* CHASEN & KLOSS of Sipora and Siberoet, *maerens* MILLER of Nias) so strongly differ from the Enggano series that detailed comparison is unnecessary. The forms *lugens* MILLER of Pagai, *simalurensis* MILLER of Simaloer, *babi* MILLER of P. Babi, *lasiae* LYON of P. Lasia, in my opinion do not at all belong to *R. rattus*, but, I think, to *R. mulleri*. The nearest relative of the Enggano rats seems to be *R. r. jalorensis* of the Malay Peninsula. But there are differences. Firstly the teeth of *vernalus* are somewhat smaller (upper toothrow 6.1 - 6.6 - 6.8 mm in 6 specimens, against 6.5 - 7.0 - 7.5 mm in 10 *jalorensis*). But the main difference lies in the colour of the underside. Though in all specimens this underside shows much white (this being the main colour), they all possess a rather to very clear dark median stripe, whereas the lateral demarcation of the colours is rather unsharp because, from there onward, over some distance the white belly hairs continue showing grey bases.

Measurements:

Number	Sex	Head & body	Tail	Huid foot	Ear	Skull: great. length	Condy-lobasal length	Basal length
315/36	♂	181	171	34	18	± 43	41.2	39.0
219/36	♂	166	164	34	19	—	—	—
303/36	♀	153	175	32	17	41.0	39.1	37.2
302/36	♀	167	172	33	17	--	38.8	36.4
316/36	♀	152	166	34	17	± 38	—	—
317/36	♀	136	152	34	17	—	—	—

Palatal length	Length of nasals	Breadth of comb. nasals	Zygomatic breadth	Interorbital constriction	Breadth of braincase	Diastema	Incisive foramina	Upper toothrow
24.1	15.4	5.1	19.5	6.6	15.1	12.3	8.0	6.7
—	—	4.0	—	6.1	15.8	—	—	6.1
23.3	14.5	4.5	19.6	6.6	15.2	11.9	7.7	6.4
22.6	15.4	4.6	19.6	6.6	15.0	11.5	7.6	6.7
—	—	—	19.0	6.5	15.2	—	—	6.7
—	—	—	—	5.1	15.0	—	—	6.8

In the fur white spines are very numerous, as well as long black piles, but in the majority of specimens they are rather thin and slender and do not make the pelage feel harsh to the touch.

I am not at all sure that THOMAS's "*Mus rattus* var." (from Poeloe Doea) relates to the present rat. For the mammae he gives 3 — 3 = 12, while I can only find 2 pairs pectoral and 3 pairs inguinal.

8. **Rattus adustus** sp. n.

Type: ♀ ad., Kiojoh, Enggano, sea-level, coll. SAÄN, 15 April 1936. In Buitenzorg Museum, No. 304/36.

Diagnosis: Of course our first thought goes to MILLER's *Mus enganus*, with the type of which the skull measurements of the present specimen agree rather well (though I certainly would not especially compare the skull of this rat to that of "a large *Mus norvegicus*", as MILLER did for his specimen). However, there are large external differences:

1. Though MILLER's skull is somewhat s m a l l e r than that of the present specimen, he gives the total length of the whole animal 48 % larger.

2. MILLER's rat has a tail of 113 % of head and body, our specimen of 82%.

3. Furthermore there are large differences in the length and composition of the fur. MILLER says that in his animal it is "of a soft almost silky texture, except along the middle of back where it becomes somewhat harsh". He only mentions the presence on the back of "slender grooved bristles, 35 mm long". Our specimen, however, on the whole back, included the sides, is abundantly furnished with hard spines. The fur is also shorter.

Measurements: Head and body 180; tail 148; hind foot 42; ear 22; skull: greatest length ± 46.5; condylobasal length 44.3; basal length 41.2; palatal length 28.5; breadth of combined nasals ± 6.6; zygomatic breadth ± 22.4; interorbital constriction 7.2; cranial width ± 18.4; diastema 13.0; incisive foramina 9.2; upper toothrow 8.7 mm.

Colour: Above very dark brown, below dark brownish grey. Tail black, with 9 rings to the cm.

It is impossible for me to insert this new, very spinous form into any polytypic species. (As for MILLER's *enganus* I suppose it to be a race of *R. mulleri*).

9. **Sus scrofa babi** MILLER.

Sus babi, MILLER, Proc. U. S. Nat. Mus., XXX, 1906, p. 752 (Pulo Babi).
Sus scrofa, OUDEMANS, Tijdschr. Kon. Ned. Aardr. Gen., 2, VI, 1889, p. 160.
Sus babi?, MILLER, Proc. U. S. Nat. Mus., XXX, 1906, p. 752, 820.
Sus babi enganus, LYON, Proc. U. S. Nat. Mus., LII, 1916, p. 454.
Sus vittatus, VON ROSENBERG, Der Malay. Arch. 1878, p. 219; DE JONG, Natuurk. Tijdschr. Ned. Ind., XCVIII, 1938, p. 35.

2 ♂, 4 ♀ (6 skulls, 5 skins; only 1 ♂, 1 ♀ nearly adult).

Material for comparison from the other islands west of Sumatra is not available. From these islands MILLER and LYON described 5 new races after totally 16 skulls, only 8 of which adult and these distributed over both sexes. This already makes it improbable that all these races can be sufficiently founded. Confining us to *enganus* (based on one old female) we see that first MILLER

wrote of this material that it was "not sufficient to make possible definite identification of the Enggano pig", and LYON himself says, after his separation of the subspecies, that "the status of this pig is very unsatisfactory". His separation exclusively depends on three measurements of the one old skull, which he compared with the conformable figures of one male skull of *babi* and one female skull of *tuancus*. On this ground he declares *enganus* to be "intermediate in characters between *Sus babi babi* (P. Babi) and *S. babi tuancus* (P. Tuangku)". This latter race had been separated from *babi* by LYON on the score of the short nasals and premaxillary bones and the long nutrient artery groove in frontal bone. *Enganus* should be intermediate in so far that the nasals and premaxillaries are long as in *babi*, the artery grooves of the frontal bones long as in *tuancus*. LYON's complete figures may be given as follows:

		Nasals	Premaxillaries	Artery grooves
babi	♂	151 mm	(115 mm)	"short"
enganus	♀	140 mm	115 mm	39 mm
tuancus	♂	127 mm	93 mm	35/40 mm

Adding the new Enggano measurements we get:

♂	143 mm	118 mm	39/42 mm
♀	139 mm	102 mm	34/35 mm

For me it is impossible to see in these figures a sufficient foundation for a race *enganus*. Series of skulls from all islands will be necessary to give us an insight into the question of the formation of races in these islands. Provisionally I bring our Enggano pigs to *babi* (accepting — also provisionally — the older race *niadensis*, founded on 3 adult skulls with clearly enlarged posterior two molars, both above and below, as a second race of the Barussan chain of islands).

The incorparation of the "*vittatus* pigs" into *S. scrofa*, as implied in the name given above, means that we now definitely wish to accept this opinion which has already been growing for a long time and was lastly maintained by KELM (Zeitschr. Tierz. & Zücht. Biol., XLIII, 1939, p. 362 - 369).

Measurements:

Number	Sex	Head & body	Tail	Huid foot	Ear	Skull: upper length	Condylo-basal length	Basal length	Palatal length	Length of premaxillary
228/36	♂	1388	257	268	106	302	289	277	196	118
214/36	♀	1205	257	280	99	283	268	258	184	102
224/36	♂	1136	195	249	92	271	—	—	—	—
300/36	♀	1050	220	220	100	257	—	—	—	—
299/36	♀	740	150	180	80	183	—	—	—	—
208a/36	♀	—	—	—	—	142	—	—	—	—

Length of nasal	Nasal br. at post. extrem. of pmx.	Zygomatic breadth	Least inter-orbital breadth	Parietal constriction	Maxillary toothrow	2nd. Upper molar	3rd. Upper molar	Mandibular toothrow	2nd. Lower molar	3rd. Lower molar
143	29	136	66	39	> 103	19.7×16.8	–×19.0	116	19 4×13.7	31.0×15.5
139	29	129	61	23	> 96	20.2×18.0	–×20.5	112	18.9×14 2	30.6×16 5
—	—	—	—	—	—	20 6×17.1	—	—	18.4×13 2	—
—	—	—	—	—	—	19.1×15.0	—	—	18.0×12.6	—
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—

Finally I may quote Mr. W. L. ABBOTT, the collector of the American material: "Pigs are very common in Enggano, but are never kept tame. They are said to be descended from some pigs which swam ashore from a stranded ship, perhaps 25 years ago. The natives say that previous to this none existed. One afternoon while I was on a shore, a pig swam off from the mainland bound for Pulo Dua". Hereto LYON adds the following comment: "I do not wish to descredit the natives' story of the Enggano pigs, but there is no zoologic and geographic reason why pigs should not occur as native animals on Enggano as well as in the Nicobars, Simalur, and Babi. It is not unlikely that the pigs reached all these outlying islands by human agency. It would seem incredible that they should be the only large animal on so many small islands unless brought by man. Doctor ABBOTT thinks the natives may have had the stranded-ship story handed down from generation to generation and that the years refer to the observation of the first generation". DE JONG gives as his opinion that probably the animals belong to the original fauna. Certain is that already in 1614 CORNELIS REYERS obtained pigs from the island (vide LEUPE, Bijdr. Taal-, Land- & Volkenk. Ned. Ind., III, 1855, p. 136). Several former travelers confirm ABBOTT's information that in Enggano no pigs were kept tame, but WALLAND writes (Tijdschr. Ind. Taal-, Land- & Volkenk., XIV, 1864, p. 103): „Onder de woning worden in daarvoor bestemde hokken varkens onderhouden", and further: „Ook voor varkens heeft men veel zorg; ik heb jonge vrouwen gezien, welke kleine wilde varkens zoogden".

Besides the forms enumerated above the following species have been collected in Enggano by other explorers:

10. **Rhinolophus calypso** K. AND.

Rhinolophus calypso, ANDERSEN, Proc. Zool. Soc., 1905, II, p. 134 (Enggano).
Rhinolophus affinis, THOMAS, Ann. Mus. Civ. Genova, XXXIV, 1894, p. 108; WILLINK, Natuurk. Tijdschr. Ned. Ind., LXV, 1905, p. 279.
Rhinolophus calypso, ANDERSEN, Proc. U. S. Nat. Mus., XXIX, 1906, p. 657, 659; MILLER, Proc. U. S. Nat. Mus., XXX, 1906, p. 824; ANDERSEN, Ann. Mus. Civ. Genova, XLIII, 1907, p. 29.

11. Hipposideros galeritus CANTOR.

Hipposideros galeritus, CANTOR, Journ. As. Soc. Bengal, XV, 1846, p. 183 (Pinang).
Hipposideros galeritus, THOMAS, Ann. Mus. Civ. Genova, XXXIV, 1894, p. 108; WILLINK, Natuurk. Tijdschr. Ned. Ind., LXV, 1905, p. 282; MILLER, Proc. U.S. Nat. Mus., XXX, 1906, p. 824.

12. Hipposideros gentilis major K. AND.

Hipposideros gentilis major, ANDERSEN, Ann. Mag. Nat. Hist., 9 - II, 1918, p. 380 (Bua-Bua, Enggano).
Hipposideros bicolor, THOMAS, Ann. Mus. Civ. Genova, XXXIV, 1894, p. 108; WILLINK, Natuurk. Tijdschr. Ned. Ind., LXV, 1905, p. 283; MILLER, Proc. U. S. Nat. Mus., XXX, 1906, p. 824.

13. Pipistrellus imbricatus macrotis (TEMM.).

Vespertilio macrotis, TEMMINCK, Mon. de Mamm., II, 1841, p. 218 (Padang, Sumatra).
Vesperugo imbricatus, THOMAS, Ann. Mus. Civ. Genova, XXXIV, 1894, p. 108; TROUESSART, Cat. Mamm., I, 1897, p. 112; WILLINK, Natuurk. Tijdschr. Ned. Ind., LXV, 1905, p. 289.
Pipistrellus imbricatus, MILLER, Proc. U. S. Nat. Mus., XXX, 1906, p. 825; ?DE JONG, Natuurk. Tijdschr. Ned. Ind., XCVIII, 1938, p. 22.
Pipistrellus curtatus, MILLER, Proc. Biol. Soc. Wash., XXIV, 1911, p. 25.
Vespertilio imbricatus, VAN BALEN, De Dierenw. v. Insul., I, 1914, p. 132.
Pipistrellus macrotis, THOMAS, Ann. Mag. Nat. Hist., 8—IV, 1915, p. 229.

14. Kerivoula hardwickii engana MILLER.

Kerivoula engana, MILLER, Proc. U. S. Nat. Mus., XXX, 1906, p. 825 (Pulo Dua, Enggano).

15. Emballonura ?peninsularis MILLER.

Emballonura peninsularis, MILLER, Proc. Acad. Nat. Sci. Philad., 1898, p. 323. (Trong, Lower Siam).
Emballonura semicauda(ta), THOMAS, Ann. Mus. Civ. Genova, XXXIV, 1894, p. 109; Ann. Mus. Civ. Genova, XXXIV, 1895, p. 665; TROUESSART, Cat. Mamm., I, 1897, p. 136; WILLINK, Natuurk. Tijdschr. Ned. Ind., LXV, 1905, p. 284; ?MILLER, Proc. U.S. Nat. Mus., XXX, 1906, p. 825.

16. Rattus (mulleri) enganus (MILLER).

Mus enganus, MILLER, Proc. U. S. Nat. Mus., XXX, 1906, p. 84 (Enggano).

17. Paradoxurus hermaphroditus enganus LYON.

Paradoxurus hermaphroditus enganus, LYON, Proc. U.S. Nat. Mus., LII, 1916, p. 442. (Enggano).
Paradoxurus fasciatus, OUDEMANS, Tijdschr. Kon. Ned. Aardr. Gen., 2, VI, 1889, p. 160.
Paradoxurus hermaphroditus, THOMAS, Ann. Mus. Civ. Genova, XXXIV, 1894, p. 105; TROUESSART, Cat. Mamm., I, 1897, p. 329; WILLINK, Natuurk. Tijdschr. Ned. Ind., LXV, 1905, p. 213; MILLER, Proc. U. S. Nat. Mus., XXX, 1906, p. 820; DE JONG, Natuurk. Tijdschr. Ned. Ind., XCVIII, 1938, p. 35.
Paradoxurus hermaphroditus parvus, POCOCK, Proc. Zool. Soc., 1934, p. 647.

It is difficult to say whether the forms looked upon in this list as monotypic species, really, as such, are endemic to the island, or at some time will have to be inserted into some polytypic species (vide HUXLEY, Bijdr. tot de Dierk., afl. 27, 1938, p. 515). Personally I was not able to find out any close relationship for them.

Not listed are squirrels, VON ROSENBERG's report (Tijdschr. Ind. Taal-, Land- & Volkenk., III, 1855, p. 373) being doubtless incorrect. WALLAND's report of „boschkatten" (wild cats) (T.I.T.L.V., XIV, 1864, p. 106) is also quite unproved and rather certainly incorrect.

The following Engganese names are given by HELFRICH (Tijdschr. Kon. Ned. Aardr. Gen., 2, V, 1888, p. 277): E k o j o k^2 for Wild Pigs, K a d e b o e k^2 for Bats, H o a n i e k^2 for *Pteropus*, E h o e w a for Rats, N a f i e^2 for *Paradoxurus*.

It is difficult to say whether the forms looked upon by me as monotypic species could, as such, are endemic to the island, or at some time will have to be inserted into some polytypic species (vide Hickson, Bijdr. tot de Dierk., afl. 27, 1938, p. 311). Personally I was not able to find out any close relationship for them.

Not listed are squirrels, von Rosenberg's report (Tijdschr. Ind. Taal-, Land- & Volkenk., III, 1855, p. 373) being doubtless incorrect. Walland's report of „boschkatten" (wild cats) (T. I. T. L. V., XLV, 1894, p. 100) is also quite unproved and rather certainly incorrect.

The following Enggano names are given by Helfrich (Tijdschr. Kon. Ned. Aardr. Gen., 2, V, 1888, p. 277): E k e i o k' for Wild Pigs, K a d a b o e k' for Bats, [illegible] for Pteropus, E h o e w a for Rats, N a i i e' for Paradoxurus.

NOTES ON *RATTUS RATTUS JALORENSIS* AND *R. R. ROQUEI*, AND ON SOME FRUGIVOROUS BATS

by

H. J. V. SODY

(Buitenzorg, Java).

Rattus rattus jalorensis (Bonh.) and **R. r. roquei** Sody.

We have to thank Dammerman (Treubia, 16, 1938, p. 423 - 436) for giving us a very fine new series of measurements of the (nearly) white-bellied *Rattus rattus* rats from Malaya (*jalorensis*) and from Java (*roquei*). To my mind these new figures once more confirm my opinion that the Javan form differs from the Malayan one, and even so much that separation is absolutely necessary.

Firstly Dammerman's figures confirm my contention that the Javanese are larger than the Malayese:

	Total length (*Average and maximum*)	Lower toothrow (*Average and maximum*)
Malay Peninsula	347 - 362 mm (10)	6.6 - 7.1 mm (10)
Java	379 - 416 mm (31)	7.0 - 7.5 mm (29)

Especially the total length (of the whole animal) seems very convincing: here the average of *roquei* largely surpasses the maximum of *jalorensis:* 24 of the 31 Javanese, measured by Dammerman, being *larger* than the *maximum* in *jalorensis*. And I may add here that Mr. C. Boden Kloss wrote me about this Malayan figure of 362 mm that it was not only the maximum of 10 specimens, but the maximum of the whole series of 100 examples preserved in the Raffles Museum.

A second difference lies in the relative length of the tail. Again confining us wholly to the figures given by Dammerman, we find for it: in *jalorensis* (average and maximum): 107 - 115 %, in *roquei:* 118 - 132 % of the length of head and body.

If further we add the (small) existing differences in the colours, then it seems difficult to understand why Dammerman continues calling my separation of *roquei* "an unwise procedure" (p. 428).

And when, finally (p. 428), he pretends that *roquei* is founded on nothing but "a difference of only 2 percent. in length in the largest examples" (sic), then I can only suppose that he did not at all see my figures (Zool. Meded. Leiden, XIII, 1930, p. 94 - 98), no more than he

seems to have *studied* those given by himself (in reality the average of *roquei* surpasses the maximum of *jalorensis* with 5 percent!).

Cynopterus sphinx terminus subsp. n.

Type: ♀ ad., Niki Niki, Central S. Timor, 750 m, coll. Mrs. M. E. WALSH, 3 April 1929. In Buitenzorg Museum, No. 2208.

Specimens examined: 6, all in Buitenzorg Museum.

Diagnosis: Externally quite like *C. sphinx titthaecheilus* of Java (same size and colours) but skull markedly shorter: greatest length of skull in 5 specimens of *terminus:* 32.5 - 33.9 mm, against 35.1 - 38.5 mm in 33 specimens of *titthaecheilus.*

Measurements of type: Head and body 99; tail 8; hind foot 13; ear 18; forearm 83; skull: greatest length 33.9; occipitonasal length 32.4; condylobasal length 32.2; basal length 30.2; palatal length 17.1; zygomatic breadth 21.9; cranial width 14.1; interorbital constriction 6.9; postorbital processes, tip to tip, 13.0; postorbital constriction 7.1; upper teeth, c-m^1, 10.8; upper teeth, p^3-m^1, 7.7; length of p^4, 2.7; of m^1 2.5; lower teeth, c-m_2, 12.2 mm.

Cynopterus brachyotis brachyotis (S. MULL.).

2 Specimens, Talaud, coll. ERI, 7 June 1926. In Buitenzorg Museum.

2 Specimens, Bawean, coll. P. F. FRANCK, 13 May 1928. In Buitenzorg Museum.

Both localities are not mentioned in ANDERSEN's Catalogue, though already in 1899 A. B. MEYER recorded the species from Talaud (AB. Mus. Dresden, VII, 7, 1899, p. 7).

Measurements:

Locality	Number	Sex, age	Head and body	Tail	Ear	Forearm	3 rd. metacarpal	Skull: great. length
Talaud	1483	(♀)	190	—	15	(67)	43.5	28.6
„	1484	imm.	90	—	15	(64)	41	27.7
Bawean	1860	(♂)	—	—	—	(63)	41.5	29.4
„	1861	imm.	—	—	—	(58)	38.5	—

Condylobasal length	Basal length	Zygomatic breadth	Interorbital constriction	Postorbital proc., t.t.t.	Cranial width	Upper teeth, c-m^1	Upper teeth, p^4-m^1	Lower teeth, c-m_2
27.7	25 5	19.2	6.9	11.9	12.5	9.2	6.3	10.3
26.4	24.4	18.2	6.1	10.4	12.9	8.6	6.1	9.6
28 4	26 3	19.2	6.1	11.7	12.3	9.3	6 5	10.5
—	—	17.9	6.2	12.2	12.4	9.0	6.3	10.1

The Talaud specimens in colour and measurements sufficiently agree with typical *brachyotis* of Borneo to allow a provisional insertion into the typical

race, though it must be said that the measurements of the arm surpass the maximum of 75 *brachyotis,* in this respect the adult Talaud animal showing an approach to *insularum* (Kangean, Mata Siri).

For the Bawean specimens a choice had to be done between *brachyotis* and *javanicus.* The small measurements (especially of the teeth) only slightly justify the choice of the Borneo form. With certainty, however, it may be said that there is no approach to *angulatus* (to which a Krakatau series was brought by Dammerman) or to *insularum* (Kangean, Mata Siri).

PRELIMINARY PLANKTON INVESTIGATIONS IN THE JAVA SEA [1])

by

Dr. H. C. DELSMAN

(Hilversum, Holland).

Errata.

p. 143, line 5, add: and slightly more than 29° C.

p. 143, line 2 from below (in note 2) "%" read: ‰.

p. 145, line 14 from below (without the note) "1 - 6" read: 4 - 6.

p. 152, line 19 "uppers", read: upper layers.

p. 153, line 19 "first group on p. ???" read: last group on p. 157.

p. 154, line 9 - 10 from below (without the note) "sample with profits" read: specimen with ciliates.

p. 157, line 9 "specious" read: spacious.

p. 158, under fig. 10 *"Labidocera acuta"* read: *Labidocera acuta* ♀ and *Oncaea conifera* ♀, to illustrate the considerable difference in size that may exist between different species of copepods (cf. p. 162 below).

p. 168, line 6, add between "1934" and "the coast seaward": (Table IV) "the impression that, if we go from".

p. 176, the notes should be read as follows:

1) According to ALLEN and CUPP (cf. note p. 153), a variety of *Coscinodiscus jonesianus* which resembles the var. *tenuis* MEISTER (MEISTER, Kieselalgen aus Asien, 1932) but, as Mr. ALLEN and Miss CUPP write me, identification is not certain; possibly a new variety.

2) diameter 107^5 μ.

3) diameter 170 μ.

The figures 40 and 41 should be turned upside down.

Under Chart 2 "1 cm = 1 cc pro $m^3 \times ½$" read: ½ cm = 1 cc pro m^3.

In the same way the indications under Charts 2 - 8 should be altered.

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[1]) *See*: Treubia 17, 1939, p. 139 - 181.

ON SOME EARTHWORMS FROM THE BUITENZORG MUSEUM. II.

By

G. E. GATES

(Judson College, Rangoon, Burma).

Since publication of the previous article in this journal (GATES 1936) several tubes of earthworms have been received from the Buitenzorg Museum. Examination of this material has made possible more accurate characterisation of certain structures of taxonomic importance such as spermathecal pores, spermathecae, male genital terminalia and testis sacs and consequently more nearly satisfactory diagnoses of several species of *Pheretima*. Unfortunately none of the material is in good condition and certain characteristics and structures that may furnish information useful in diagnosis and determination of interspecific relationships are still unknown or inadequately described.

The author's thanks are extended to the Director of the Buitenzorg Museum for the opportunity of studying this material.

Family MEGASCOLECIDAE.

Genus **Pheretima** KINBERG.

Pheretima baweanensis MICHAELSEN.

Pheretima baweanensis MICHAELSEN 1924, Treubia, vol. 5, p. 389. (Type locality Bawean Island, Java Sea. Type in Buitenzorg Museum.)

Material examined. — 1 undissected, clitellate specimen labelled, "*Pheretima baweanensis* MICH. (Type!) Bawean, N., H. C. DELSMAN, No. 10".

External characteristics. — The setae begin on ii and appear to be enlarged on ii-v. Ventrally on vi-vii setae are retracted so that the tips are just visible in the parietes, hence an appearance of smallness in these segments may only be a result of retraction although spacing is closer than anteriorly. Setal formula: v/10, vi/13(?), xvii/18, xviii/9 +, xix/20, 15/ii, 25/iii, 36/viii, 44/xii, 56/xx.

The first dorsal pore is on 12/13.

The clitellum is annular, extending from 13/14 to 16/17; intersegmental furrows and dorsal pores lacking, setae lacking or invisible.

Spermathecal pores are superficial, large, transversely slit-like, one pair, on 5/6.

The single female pore is median.

Male pores are minute and invaginate, each pore on the posterior face near the base of a bulb protuberant from the roof into a copulatory chamber. The bulb probably narrows to a rather bluntly rounded tip but is softened so that accurate characterisation is impossible. Apertures of the copulatory chambers are transversely slit-like with finely wrinkled margins.

I n t e r n a l a n a t o m y. — Septum 8/9 is present and complete but delicate and transparent, adherent to the gizzard in a posteriorly directed funnel-like fashion, clearly visible on first opening the wall by a mid-dorsal incision but ruptured when the body wall is pinned out and after rupture recognizable only as a ventral rudiment. Septum 9/10 is lacking; 10/11-12/13 muscular, 13/14 slightly muscular.

The intestine begins in xvi just at 15/16. Intestinal caeca are simple, the right caecum with smooth (?) dorsal and ventral margins, the left caecum with six very short lobes of the ventral margin, failure to recognize lobes on the right caecum perhaps the result of softening.

There is a pair of hearts belonging to ix. The last hearts are in xiii; all hearts of ix-xiii passing into the ventral trunk.

Testis sacs are paired, the sacs of a segment not in contact mesially. The smaller posterior sacs are not in contact anteriorly with 10/11 but are crowded against the anterior face of 11/12 by the ventral portions of the anterior seminal vesicles. An opaque cord passes from the apex of each testis sac to the posterior face of 10/11. Seminal vesicles are fairly large and in contact transversely above the dorsal trunk. Each vesicle is provided with a finger-shaped dorsal ampulla which is one to two mm long. Prostates extend through xvi-xix. The prostatic duct is about 2½ mm long.

The copulatory chamber is large, approximately spheroidal, reaching into the coelomic cavity of xviii to a height of two mm. The lumen is nearly filled by the penial bulb previously mentioned. On the posterior face of this bulb, near the roof of the copulatory chamber is a deep, quite definite, slit-like depression. Close to this slit is a tiny, rather conical protuberance with a slightly greyish translucent spot on the tip. The prostatic duct cannot be traced to a male pore as a result of the maceration but appears to pass within the bulb only to the region of the slit and tubercle.

The spermathecal duct is shorter than the ampulla, rather top-shaped, thickest entally, a slight muscular sheen visible only after a thin layer of tissue (and associated nephridia?) has been dissected off. The wall is not especially thick, provided internally with fairly high longitudinal ridges except in the region of the diverticular aperture which is surrounded by an annular ridge peripheral to which are several short ridges. The saccular, thin-walled ampulla opens into the duct through a tiny, transversely slit-like aperture at the centre of the dorsal face of the duct. The diverticulum which passes into the median face of the duct slightly below the ental end comprises an unusually slender

stalk and a simple, ellipsoidal seminal chamber of about the same length as the stalk. The seminal chambers have a spermatozoal iridescence.

Remarks. — Although the specimen described above bears a type label it had not been opened by MICHAELSEN. The other worm from which the internal structures were characterized presumably is in the Hamburg Museum.

Diagnosis. — Bithecal; spermathecal pores large, superficial, transverse slits on 5/6. Male pores minute, each pore on the posterior face near the base of a rather large penis pendent from the roof of a large copulatory chamber. Setae enlarged on ii-v: v/10, vi/13, xvii/18, xviii/9, xix/20, 15/ii, 25/iii, 36-44/viii, 44/xii, 56/xx. First dorsal pore on 12/13. Length 160-170 mm. Diameter 5 mm.

Septum 8/9 complete but membranous. Intestinal caeca simple but with small lobes on the ventral margin. Testis sacs paired and ventral. Spermathecal duct shorter than ampulla, rather top-shaped and narrowed ectally; diverticulum with simple ellipsoidal seminal chamber and slender stalk passing to median face of duct entally.

Distribution. — Known only from the type locality, Bawean Island in the Java Sea.

Pheretima halmaherae MICHAELSEN.

Perichaeta halmaherae (part only?) MICHAELSEN 1896, Abh. Senck. Ges. vol. 23, p. 208. (Type locality Halmahera Is. Types in Frankfort Mus.?)
Pheretima halmaherae MICHAELSEN 1934, Arch. Neerl. Zool. vol. 1, p. 111.

Material examined. — Two clitellate specimens labelled, "*Pheretima (Ph.) halmaherae* (MICH.). Goegoeti, Morotai. vi. 26, H. J. LAM."

External characteristics. — The setae begin on ii, on which segment there is a complete circle, and are small, closely spaced. Formulae: viii/8, xvii/11, xviii/4, xix/12, 66/viii, 70/xii, 76/xx; viii/7, xvii/13, xviii/2, xix/3.

The first dorsal pore is on 11/12 (1) or 12/13 (1).

Spermathecal pores are superficial, large, transversely slit-like, two pairs, on 7/8-8/9. The anterior margin of the spermathecal aperture is tumescent, the tumescence continued into an ectal portion of the duct. On the tumescence there is a vertical groove.

The single female pore is median (2).

Male pores are minute and superficial, each pore very slightly posterior to the setal circle, on the anterior wall of a very slight depression of nearly circular outline.

Genital markings are small, in part recognizable with difficulty. On one worm there are paired postsetal depressions on xvii and xix (in line with male pore depressions) in each of which there is a marking, an additional marking

possibly present in each depression of xvii. In each of the depressions of xviii there are two more markings (or rudiments of markings), one just median to the male pore and one on the posterior wall, a further marking just lateral to the depression on each side and in line with the male pore. On the left side of xvii and on the right side of xix there is a presetal marking. On the second specimen there are paired, presetal markings on xvii-xix and paired postsetal depressions on xvii and xix each of which contains two tiny markings. In addition there are three further markings on each side of xviii located about as on the other worm, one just median to the male pore, one on the posterior wall of the depression and one in the setal circle just lateral to the depression.

Internal anatomy. — Septum 8/9 is lacking; 9/10 probably present, membranous, bulged posteriorly, adherent to the parietes and the anterior face of 10/11 and there covering over the hearts of x.

The intestine begins in xv (2). Intestinal caeca are simple but with several short incisions of the ventral margins (2).

The single heart of ix is on the right side (1) or on the left side (1). The last pair of hearts is in xiii (2), all hearts of ix-xiii passing into the ventral trunk (1).

Testis sacs are unpaired and suboesophageal, the ventral blood vessel in the roofs of the sacs. In spite of maceration walls of the sacs are strong so that the condition is easily determined. Seminal vesicles are medium-sized, vertically placed bodies on the posterior faces of their septa, each vesicle continued dorsally into a finger-shaped appendage that appears not to be constricted off from the ventral lamina. Prostates are small; in xvii only, xvii-xviii or xvi-xviii. The prostatic duct is 2 - 3 mm long, muscular, thick and rather spindle-shaped.

The spermathecal duct is slightly shorter than the ampulla and not especially thick. The diverticulum which passes into the anterior face of the duct near the parietes is longer than the main axis, with a (muscular?) stalk and a simple, sausage-shaped seminal chamber of about the same length as the stalk. Ectally the diverticular stalk is nearly as thick as the duct. The latter has a rather thin wall and is provided internally with low longitudinal ridges. The diverticular aperture is located on a small tubercle on the anterior wall.

Genital marking glands are sessile on the parietes.

Remarks. — The diagnosis below is only tentative. Several formae or subspecies have been named by MICHAELSEN but the status of all of these is uncertain. There is considerable intraspecific variation as to location of the genital markings if all of the forms are to be included in one species. Some of the supposed variations as to spermathecal characteristics may be pathological or even the result of maceration.

Diagnosis. — Quadrithecal; spermathecal pores large, superficial, transverse slits on 7/8 - 8/9. Male pores minute and superficial, each pore slightly postsetal and on the anterior wall of a slight depression of circular outline.

Genital markings small; paired and presetal on xvii-xix, two markings in each male pore depression, one median and one posterior to the male pore, one marking just lateral to the depression and in or just behind the setal circle, paired postsetal depressions on xvii and xix in line with and of same size as male pore depressions, each containing one or two markings. Setae: viii/7 - 8, xvii/11 - 13, xviii/0 - 4, xix/13, 66/viii, 70/xii, 72 - 76/xx. First dorsal pore on (11/12) 12/13. Length 130 - 220 mm. Diameter - - 8 mm.

Septum 9/10 present but membranous. Intestinal caeca simple but with shortly lobed ventral margins. Testis sacs unpaired and ventral. Spermathecal duct shorter than the ampulla; diverticulum with simple ellipsoidal seminal chamber and stalk passing to anterior face of duct near the parietes. Genital marking glands sessile on the parietes.

Pheretima indica (HORST).

Megascolex indicus HORST 1883 (part), Notes Leyden Mus. vol. 5, p. 186. (Types with copulatory chambers. Type locality unknown. Types in the Leiden Museum?).

Material examined. — 3 clitellate specimens from a tube labelled, "*Pheretima capensis* (HORST). Buitenzorg. 6. 1912. KONINGSBERGER."

The worms are quite characteristic and with secondary seminal chambers on the spermathecal diverticula.

Pheretima javanica (KINBERG).

Rhodopis javanica KINBERG 1867, Öfv. Ak. Förh. vol. XXIII, p. 102. (Type locality Java. Types in the Stockholm Museum.)

Pheretima capensis + *P. quadragenaria* GATES 1936, Treubia, vol. 15, pp. 380 and 391.

Material examined. — One aclitellate, one partially clitellate, eleven clitellate specimens and two clitellate anterior fragments from which internal organs had been removed, labelled, "*Pheretima capensis* (HORST). Buitenzorg. 6. 1912. KONINGSBERGER", and one clitellate specimen labelled, "*Pheretima capensis* (HORST). Kananggar, Soemba. 700 m. 5. 1925, K. W. DAMMERMAN."

External characteristics. — Setae begin on ii. On many of the specimens there are gaps in the setal circles. In such gaps there may be visible pits from which setae have fallen out, while other gaps (doubtless the result of the same process) have no pits or pit-like markings. In the formulae below, the second figure, that following the + sign, indicates the number of setal pits from which setae appear to have fallen out but recently while an interrogation mark indicates that the number of pits is unknown.

Setal formulae.

viii	xvii	xviii	xix	iii	viii	xii	xx
17+2	11	5	12	25+3	39+3	33+5	43+5
16	11	4	12	35	43	45	45
14+2	10	3	11	34	37	42	44
10+7	7+4	1+7	6+4	24+?	30+?	39+?	37+?
6+10	11	0+3	8+3	32	29+?	42	39+?
3+?	6+4	5	9+2	—	—	—	—
12+5	13	7	14	30	38	44	46
6+6	13	5+2	12	—	—	47	—
9+7	8+3	4+2	9+2	—	—	—	—
16	—	5	—	—	—	—	—

Counting the pits as setae, leaving out of consideration those numbers in which setal pits are not included, the setal figures do not differ markedly from those of specimens previously examined (Gates, 1936). The specific setal formula can be expressed as follows: — viii/12 - 20, xvii/10 - 13, xviii/0 - 10, xix/10 - 14, 30 - 42/iii, 37 - 47/viii, 42 - 54/xii, 44 - 56/xx.

The first dorsal pore is on 7/8 (3 or possibly 4 specimens), 8/9 (1), 9/10 (1), 10/11 (2), 13/14 (1).

The clitellum is annular, extending across xv and portions of xvi and xiv but not reaching to 13/14 or 16/17 on any of the specimens; dorsal pores and intersegmental furrows lacking, setae lacking or invisible.

Spermathecal apertures are transversely placed, usually slit-shaped, on one specimen crescentic, usually very small, but on one specimen large and one intersetal interval wide.

Apertures of the copulatory chambers are rather crescentic in shape and with the appearance of being slightly diagonal. Copulatory chambers are usually slightly relaxed, relaxation indicated by a slight eversion of the anterior wall of the chamber as a rounded bulb.

Genital markings are lacking.

Internal anatomy. — Septum 8/9 is either lacking or unrecognizable. As in the previous specimens (Gates 1936) the characteristics and relationships of septa 9/10 and 10/11 have not been definitely determined. Anterior and adherent to the first pair of seminal vesicles is a membrane which in some specimens at least appears to be double mesially (towards the gut). Between this membrane and 11/12 and especially between the seminal vesicles and the gut are strands of delicate tissue. All of the specimens are too soft to permit of more adequate characterization.

The intestine begins in xv (8) or xvi (1). The intestinal caeca are simple, the margins smooth or with slight septal constrictions.

The single heart belonging to ix is on the right side (6) or the left side (3).

The last pair of hearts is in xiii (9), all hearts of ix-xiii passing into the ventral vessel (3).

Testis sacs are paired, the sacs of a segment separated midventrally (3). Seminal vesicles are fairly large, the vesicles of a segment in contact with the dorsal blood vessel and nearly filling the coelomic cavity (9). Prostates are well developed in all specimens, extending through xvi or xvii to xx, xxi or xxii. The prostatic duct is about two mm long, fairly stout, straight or nearly straight or bent into a U-shaped or S-shaped loop, passing into the copulatory chamber anterolaterally (rarely laterally) close to the parietes. Copulatory chambers are usually recognizable as hemispheroidal protuberances into the coelomic cavity of xviii. In the partially clitellate specimen the copulatory chamber is quite unrecognizable internally, the prostatic duct passing into the parietes as if there were no chamber (seminal vesicles, prostates and spermathecae fully developed, testis sacs small). An invagination containing the primary male pore is however present in the parietes and recognizable after removal of strands of longitudinal musculature.

The wall of the chamber is fairly thick, perhaps thicker anteriorly and dorsally than posteriorly. On removal of the roof or after opening the chamber from the dorsal side there comes into view a protuberance from the floor of the chamber immediately anterior to the slit-like passage to the exterior through the parietes. On this protuberance there is always present a very tiny slit within which is the primary male pore. As a result of softening the male pore protuberance cannot be definitely characterized. In one specimen the male porophores have more of an appearance of being projections from the anterior wall than from the floor of the chamber but in this worm as well as in the previous specimens (GATES 1936) the male pore is on the dorsal side of the porophore. As has already been noted above, copulatory chambers appear to be slightly relaxed, especially the anterior wall which appears to be in the initial stage of eversion. In previous specimens the male porophores were described as protuberant into the lumen of the copulatory chamber from the anterior wall. Presumably in such specimens the chambers were less relaxed than in the present worms, possibly fully retracted.

The thick-walled ectal portion of the diverticulum, which may as well be called the stalk, is well developed in all specimens but may be either C-shaped or spirally coiled. Correlation of differences in the diverticular stalk with numbers of spermathecal setae on viii or other external characteristics is impossible. A specimen with sixteen spermathecal setae on viii and no setal gaps has diverticular stalks tightly coiled in a spiral fashion, while one specimen with C-shaped diverticular stalks has but few setae on viii. The shape of the seminal chamber is variable; shortly ellipsoidal, pear-shaped, almost spheroidal. The seminal chamber may be separated from the stalk by a slender neck that is short, as long as or slightly longer than the seminal chamber, or the neck region may be entirely lacking, the seminal chamber marked off from the stalk only by a slight constriction. Spermatozoal iridescence is visible in a number

of seminal chambers provided with necks but no iridescence has been seen in diverticula without definite necks. The partially clitellate specimen (setal circles present on all clitellar segments) has seminal chambers with spermatozoal iridescence and unusually short necks.

P a r a s i t e s. — In two specimens seminal vesicles are almost entirely masses of gregarine cysts that fell apart on the slightest traction.

R e m a r k s. — As a result of maceration characterization of wall and lumen of the spermathecal diverticulum is scarcely worth while. The Soemba specimen is coiled and brittle.

MICHAELSEN (1922) distinguished *quadragenaria* from *capensis* by the absence of a neck region between stalk and seminal chamber of the spermathecal diverticulum, length of the diverticulum, thinness of the circular muscle layer in the diverticular stalk, presence of a network of ridges on the lining of the seminal chamber, ventral restriction of the testis sacs of x, and certain unimportant characteristics of the post-gizzard septa. These criteria have to do only with internal organs. In the previous paper it was pointed out that some of the specimens identified by MICHAELSEN as *variabilis* (= *quadragenaria*) have *capensis* characteristics and it is now equally clear that the specimens identified as *capensis* by MICHAELSEN may have *quadragenaria* characteristics. A previous attempt to distinguish *capensis* and *quadragenaria* (GATES 1936) by the number of spermathecal setae on viii and the method of coiling of the spermathecal diverticula is now demonstrated to be unsuccessful. So far as the material from the Buitenzorg Museum is concerned the two species cannot be distinguished by any external or internal characteristics and obviously must be united.

The type locality of *quadragenaria* is unknown, that of *capensis* probably has been mistakenly given as Cape of Good Hope, while that of *javanica* is Java! MICHAELSEN (1899) examined the originals of *javanica* and found that the particular specimen to be regarded as KINBERG's type was, so far as could be determined in absence of an anterior portion containing the spermathecae, probably *capensis* ("scheint dieses Stück der Art *Amyntas capensis* HORST anzugehören", MICHAELSEN, 1899, p. 439). So far as can be discovered from the literature the species under consideration appears to be the most common in Java of any of its size and the one most likely to have been collected by the Eugene expedition. It is unlikely that any of the type material (of *javanica, capensis* or *quadragenaria*) is in a condition to be of use today. In these circumstances the species under consideration may as well have the name *javanica*.

According to MICHAELSEN many of his specimens of *quadragenaria* are characterized by peculiarities such as absence of prostates, rudimentary or stunted prostates, adiverticulate spermathecae, rudimentary spermathecal diverticula or diverticula with incompletely developed seminal chambers and neck regions. All of these conditions are clearly abnormalities and further of those types that may be produced by infestation of parasites during juvenile stages. Thinness of the circular muscle layer in the diverticular stalk and the stunting

of the testis sacs of x (restriction to a ventral location) are quite probably abnormalities as may also be the unusual length of spermathecal diverticula and the network of ridges on the lining of the spermathecal chamber.

D i a g n o s i s. — Quadrithecal; spermathecal apertures on 7/8 - 8/9. Male pores minute, each pore within a tiny slit on the dorsal face of a penial protuberance into a copulatory chamber from the anterior wall. Setae: viii/12 - 20, xvii/10 - 19, xviii/0 - 10, xix/10 - 19, 30 - 42/iii, 37 - 47/viii, 52 - 54/xii, 44 - 56/xx. First dorsal pore on or between 7/8 - 13/14. Length 70 - 220 mm. Diameter 3 - 6 mm.

Septum 10/11? Intestinal caeca simple. Testis sacs paired, of x vertical, of xi ventral. Spermathecal duct shorter than ampulla; diverticulum longer than the main axis, thicker than the duct; elongate stalk separated from the shortly ellipsoidal, pear-shaped, or spheroidal seminal chamber by a short and slender neck.

Pheretima omtrekensis COGNETTI.

Pheretima omtrekensis COGNETTI 1911, Boll. Mus. Torino, vol. 26, No. 641, p. 3. (Type locality, Humboldt Bay, Dutch New Guinea. Type in Amsterdam Museum.)

Pheretima omtrekensis GATES 1936, Treubia, vol. 15, p. 390.

M a t e r i a l e x a m i n e d. — 1 much macerated perhaps partially clitellate specimen, labelled, "*Pheretima keiana* MICH. (Type!) Gn. Daab. 300 m. Groot Kei. iv. 1922. H. C. SIEBERS."

E x t e r n a l c h a r a c t e r i s t i c s. — There are four spermathecal setae on viii. Three of the spermathecae had been removed but the left pore on 7/8 is still recognizable. There is a tiny genital marking just anterior to and just posterior to this pore.

The parietes in the clitellar region has a slightly different appearance than elsewhere, but setae are visible in all clitellar segments.

Genital markings are small tubercles with protuberant, narrow rims and concave central areas, located as follows. — A pair of presetal markings on x, separated from each other by a midventral distance equal to 3 intersetal intervals. A transverse row of three markings on 16/17 (or presetal on xvii), two markings just to the right of the midventral line, one marking left of the midventral line and at about the same distance as the more lateral of the right markings, all three median to the male pore lines. One pair of markings each on 17/18 and 18/19, each marking slightly lateral to the male pore lines. Just median to the male pore lines, a postsetal pair on xviii, a presetal marking on xix-right side, intersegmental pairs on 19/20 and 20/21.

I n t e r n a l a n a t o m y. — The prostatic duct is straight, 1½ - 2 mm long.

The seminal chamber is spheroidal, only slightly wider than the rest of the spermathecal diverticulum and one-fourth to one-fifth as long. The diverti-

culum passes into the median face of the duct below the ental end. On the parietes close to the ectal end of the duct are two tiny, sessile glands, one rather anterolateral, the other rather posteromedian.

Glands of the genital markings appear to be sessile on the parietes.

Remarks. — Most of the internal organs had been removed by MICHAELSEN. The body wall is transparent, intersegmental furrows usually unrecognizable.

Spermathecal pores cannot yet be characterized. They may be large and superficial or minute and invaginate, the presence of tiny tubercles within the spermathecal openings of the previous specimen (GATES 1936, p. 390) perhaps indicative of parietal invaginations into which minute pores open. Relationships of testis sacs and seminal vesicles of xi are also unknown.

Diagnosis. — Quadrithecal; spermathecal apertures transverse slits on 7/8 - 8/9. Male pores minute and very slightly postsetal. Genital markings paired: lateral to the male pore lines on 16/17 - 20/21 and postsetal on xix-xx; median to or about on male pore lines on 16/17 - 23/24, presetal on viii-x, xvii-xix, postsetal on x, xvii-xxi; one marking just in front of and one just behind each spermathecal aperture. Setae: viii/6, xvii/7, xviii/0 - 5, xix/7, 72/xiii, 75/xxv. First dorsal pore on (11/12) 12/13. Length 60 - 130 mm. Diameter 2½ - 6 mm.

Septum 9/10 present but membranous. Intestinal caeca simple but with ventral margins lobed. Testis sacs paired, vertical (?); seminal vesicles of xi included? Spermathecal duct about as long as ampulla; diverticulum about as long as main axis, to ental portion of duct, seminal chamber simple, ellipsoidal, a widened and pear-shaped middle region with thick wall and widened lumen constricted off from seminal chamber, and about as long as stalk. Genital marking glands stalked and coelomic?

Pheretima sangirensis (MICHAELSEN).

Perichaeta sangirensis MICHAELSEN 1891, Mitt. Mus. Hamburg, vol. 8, p. 36. (Type locality, Sangir. Types in the Hamburg Museum?)

Pheretima sangirensis MICHAELSEN 1934, Arch. Neerl. Zool. vol. 1, p. 113.

Material examined. — Two clitellate specimens labelled, "*Pheretima* (*Ph.*) *sangirensis* (MICH.) Lobo, Karakelong (Talaud), Juni 1926. H. J. LAM."

External characteristics. — Red pigment is still visible in the dorsum, especially anterior to the clitellum, in spite of the alcoholic preservation.

The setae begin on ii on which segment there is a complete or nearly complete circle. Formulae: vii/12, viii/13, xvii/14, xviii/5, xix/15, 21/ii, 31/iii, 37/viii, 32+/xii, 51/xx; vii/11, viii/14, xvii/13, xviii/7, xix/14, 26/ii, 26/iii, 40/viii, 44/xii, 60/xx. (Setal pits have been counted as if setae were present in several of the segmental enumerations). The tips of the ventral setae of vii are ornamented by transverse rows of fine spines, the rows of varying length.

The first dorsal pore is on 11/12 (2).

The clitellum is annular, extending from 13/14 to 16/17; intersegmental furrows and dorsal pores lacking, setae lacking or invisible.

Spermathecal pores are superficial, large, transversely slit-like, one pair, on 7/8.

The single female pore is median (1).

Male pores are minute and invaginate, each pore at the ventral tip (?) of a penis about 1 mm long pendent from roof of a large copulatory chamber with a transversely slit-like aperture. The penis has a rather bluntly rounded tip and is slightly thickened basally.

I n t e r n a l a n a t o m y. — Septum 8/9 is present and complete but membranous, recognizable on first opening the animal by a mid-dorsal incision as a posteriorly directed, rather funnel-shaped membrane investing the gizzard, but ruptured by pinning out the body wall so that only a ventral rudiment is then recognizable.

The intestine begins in xv (2). Intestinal caeca are simple but with 3 - 7 very short lobes on the ventral margins (2).

The single heart of ix is on the left side (2). The last pair of hearts is in xiii (2), all hearts of ix-xiii passing into the ventral trunk (1).

Testis sacs are paired and separated midventrally, fairly large and may reach upwards nearly to the level of the dorsal face of the gut. Seminal vesicles are rather small, vertically placed bodies on the posterior faces of their respective septa, each vesicle with a finger-shaped primary ampulla 1 - 1½ mm long. Prostates extend through xvii-xix and may be separated into two distinct lobes. The prostatic duct is three to four mm long, bent into a U-shaped loop, the thickened ectal limb passing into the centre of the dorsal face of the copulatory chamber. The latter is conspicuously protuberant into the coelomic cavity of xviii but is rather small, exceeded in size by two glands attached to the anterior and posterior faces. These glands are marked off from the chamber by deep, transversely placed dorsal clefts or grooves. The anterior gland is actually in xvii and reaches into contact with 16/17. The posterior gland appears to be in xviii, but pushing 18/19 back into contact with 19/20. Protuberant from the walls of the copulatory chamber and in contact with the penis are four or five tumescences that may perhaps be genital markings bearing gland pores.

The spermathecal duct is shorter than the ampulla and is not slender, the lumen rather large, the wall rather thin and provided internally with slight longitudinal ridges The diverticular aperture is on a tiny papilla on the posterior wall. The diverticulum comprises a very slender stalk which may be looped in a rather zigzagged fashion and a much thicker simple, ellipsoidal seminal chamber of about the same length as the stalk. The stalk passes to the posterior face of the duct apparently at or near the ental end but actually does not open into the duct until lower down nearer the parietes, an ectal portion of the stalk bound to the duct by tough tissue which may be continued entally along the

stalk to or nearly to the seminal chamber, the real width of the diverticular stalk and the relationship of stalk to duct not obvious until after removal of the tissue.

Remarks. — As a result of maceration structures within the copulatory chambers which may be of taxonomic importance cannot be satisfactorily characterized.

Diagnosis. — Bithecal; spermathecal pores superficial, transverse slits on 7/8. Male pores minute, each pore at ventral end of a 1 mm long penis pendent from the roof of a large copulatory chamber. Setae: vii/11 - 12, viii/13 - 14, xvii/13 - 14, xviii/5 - 10, xix/14 - 15, 21 - 26/ii, 26 - 31/iii, 37 - 40/viii, 40 - 44/xii, 51 - 60/xx. First dorsal pore on 11/12. Length 50 - 240 mm. Diameter 4 - 8 mm.

Septum 8/9 present, membranous. Intestinal caeca simple, with few short lobes on ventral margin. Testis sacs paired, vertical. Glands on anterior face and posterior faces of each copulatory chamber large (markings within the chamber?). Spermathecal duct shorter than ampulla; diverticulum with simple ellipsoidal seminal chamber and a slender stalk passing to ental end of and bound to posterior face of duct but opening ectally.

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THE BIRDS OF GOENOENG API [1]).

By

A. C. V. VAN BEMMEL and A. HOOGERWERF [2])

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1. Particulars about Goenoeng Api.

The island Goenoeng Api (Fire-mountain), situated in the South-Banda sea, 60 - 70 km north of the island of Wetar (Zuidwester Islands), is formed by the summit of a volcano, rising directly from the Ocean bottom, 4000 meters deep to about 280 m above sea-level, forming an island approximately one km square.

This andesitic volcano, still in the solfatara stage, is uninhabited, although it is visited by fishermen from time to time.

Its inaccessible position, the isolated situation, and the fact that the island is reputed to be inhabited by demons, are probably causes which prevent frequent visits by man.

The Volcanological Survey did not possess data as to the time of the last eruption of the volcano. Solfatara, showing copious vapour formation with locally, high temperatures, is all that now remains of former activity. The lava has taken its course to the west, the western slope shows a broad zone of thousands of lava blocks, partly covered by vegetation.

In the centre of the island the ± 80 m deep crater is found, the lowest edge is on the W. side, 200 m above sea-level.

Dr. PH. F. KUENEN, as geologist of the "Willebrord Snellius Expeditie" (1929 - 1930) visited the island in April 1930. He comments upon this visit as follows: "This small island ....is peopled by enormous flocks of seabirds, but the climate does not allow of the formation of guano. The crater is opened on one side and two more great land slides have occurred on other sides of the island, one of which is submarine only" [3]).

Because of the fact that Dr. KUENEN mentions a number of nesting oceanic birds, the Neth.-Ind. Soc. for Nature Protection approached the Neth.-Ind. Government in 1936 in an endeavour to have the island established as a nature reserve. A favourable decision was reached in December of the same year.

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[1]) Papers on the same subject appeared already in:
a) Limosa 12, 1939, p. 43 - 79 and p. 141 - 165. b) 3 Jaren Indisch Natuurleven (11th Report 1936 - 38 of the Neth. Ind. Soc. for Nature Protection), Batavia 1939, p. 316 - 333. c) De Trop. Nat. 28, 1939 p. 27, 41, 82, 107, 127, 150.

[2]) The different parts of this paper are signed by the author: V. B. (VAN BEMMEL) or H. (HOOGERWERF). For each part only the author of this part is responsible.

[3]) Scient. Results of the Snellius Exp. etc, I p. 174.

Except for very steep slopes and other barren places the island is entirely covered by vegetation which is, however, poor in species.

The author who visited the island from July 21 till August 11, 1938, noted in total twenty five species of plants which number should approximate the total number of species actually existing. Among the higher vegetation we observed *Pisonia sylvestris, Ficus, Terminalia catappa, Pandanus tectorius* and a few coconut palms, while the shrub was almost exclusively formed by *Trema virgata, Trema orientale* and *Caesalpina crista*. Among the herbs we name *Cenchrus inflexus, Cyperus* sp., *Paspalum scrobiculatum* (on the crater bottom) and *Ipomoea pes caprae*. **H.**

2. The fauna of the island.

Except for the Oceanic-birds, the fauna appears to be very poor. During our sojourn not a single mammal was observed except for a large bat of unknown species. Every day dozens of rat-traps were laid out with various vegetable and animal bait, but not a single mammal was caught.

The number of non-oceanic birds was small, not more than 9 species could be observed, viz:—

Hypotaenidia philippensis nov. subspec. .... (collected)
Halcyon sancta sancta VIG. & HORSF. .... „
Coracina novaehollandiae melanops (LATH.). .... „
Zosterops palpebrosa lettiensis FINSCH. .... „
Megapodius? sp. .... (only seen)
Falco peregrinus subsp. .... „
Demigretta sacra sacra (GMEL.). .... „
Collocalia sp. .... „
Charadriidae. .... (heard)

Of *Falco peregrinus, Demigretta sacra* and *Collocalia* sp. only a single specimen was seen, while none of the other species was of common occurrence. No reptiles were observed, a striped sea-snake and small tree-lizards excepted. The snakes were not uncommon near the shore but did not occur at higher altitudes. The lizards were seen a few times in the wood around our camp. No *Varanus* nor land-snakes, which may do great damage in tropical bird colonies, were observed.

Among the evertebrate animals one species of crab was very common. A few times this animal was observed eating bird-eggs. Insects were also poorly represented. In addition to louse-flies (*Hippoboscidae*), which occur in the feathers of many oceanic birds, some butterflies were observed on a few occasions, while grasshoppers were seen fairly regularly. Aside from the isolated situation of the mountain the poor fauna may be caused by the dearth of fresh water. An intensive search for fresh water was organized since our water-stores decidedly decreased in quality, but no source was found not even after some heavy rain-storms. The more remarkable therefore appears the presence of

birds which we thought could not live without fresh water, like *Rallidae* and *Megapodius.*

As our sojourn seemed not to coincide with the extreme dry season, because the vegetation covered the mountain with a lush green, the situation seemed comparatively favourable. **H.**

3. General remarks on the oceanic birds of Gg. Api.

The great number of oceanic birds which brood on this island and the large number of specimens residing there outside the brooding season, are in pleasant contrast to the above mentioned poverty of other fauna. Although Gg. Api cannot compete numerically as a bird-island with analogous places in moderate or arctic zones we do not hesitate to call this volcano a very important tropical bird-colony, the protection of which is of great ornithological importance.

The following oceanic birds were observed:—

Sula dactylatra bedouti MATH.	(brooding and with young)
Sula leucogaster plotus (FORST).	(with young)
Sula sula rubripes GOULD.	(brooding and with young)
Fregata minor minor (GMEL.).	" " " "
Phaeton rubricauda westralis MATH.	" " " "
Anous stolidus pileatus (SCOP.).	" " " "
Sterna anaetheta anaetheta SCOP.	" " " "
Sterna fuscata nubilosa SPARRM.	(with full fledged young)

Most numerous was the tern *Anous stolidus* of which several hundreds of specimens were seen. Almost as numerous were *Sterna fuscata, Sula leucogaster, Sula sula* and *Fregata minor.* The Tropic Bird, *Phaeton rubricauda,* we suspect to be less numerous, although an actual census would be difficult on account of the cave-dwelling habit of these birds. Least common was the large booby, *Sula dactylatra,* and the Bridled Tern, *Sterna anaetheta.*

Birdlife seemed centered on the western slope of the volcano which is probably due to the occurrence of solfatara. Certain species (*Sula dactylatra, Sterna fuscata* and *Anous stolidus*) seem to actually seek the solfatara probably on account of the higher temperature. Moreover, this slope is on the lee-side and is therefore protected from the dry eastern monsoon winds.

The birds may be divided in two groups, those that nest in trees, and those nesting on the ground. To the first group belong *Sula sula* and *Fregata minor* and to the second *Sula dactylatra, Phaeton rubricauda, Sterna anaetheta,* and probably also *Sula leucogaster* and *Sterna fuscata,* while *Anous stolidus* seems to brood on the bare ground or between rocks as well as in shrubs and trees.

The breeding season was apparently at its height when we visited the island. The young of *Sula leucogaster* and *Sterna fuscata,* however, were almost without exception able to fly and no eggs were seen, so in these species the brooding-period was already over. In the case of all other species both small and almost full-grown young as well as freshly laid or incubated eggs were found. Due to our

short stay at the island the incubation time of various species could not be established.

The same reason holds good for the incompleteness of data concerning the age of the young birds, though many observations make it possible to do certain reliable estimations while in other cases the age could be established with certainty. If we take one month for the incubation period of the larger species and if we assume that the young are able to fly at an age of ten weeks, we obtain differences in season for the same species of at least 3½ months.

In the case of *Sula dactylatra, Sula sula, Fregata minor* and *Anous stolidus* the number of clutches in relation to the total number of birds seemed anything but small. Therefore, these clutches could not be considered retarded, as often can be found in tern-colonies. This situation appeared normal, and is true also for allied races of these birds at other places (Phillipines, Galapagos islands and elsewhere).

Dr. Kuenen found on his visit on April 14, 1930, a rather similar situation. A few species were brooding and also had young, as shown by his photographs.

During our visit the number of nest-building birds was small, however, so that we suppose that after our sojourn on the island the number of clutches did not considerably increase.

With a view on the important number of not-brooding birds that regularly visited the volcano, we may suppose that Gg. Api also lodges a big bird-population beyond the brooding season.

The feeding places of these oceanic birds apparently were situated, at least during our visit, at considerable distance from the volcano. Birds flying outward could not be followed even with powerful binoculars while homebound individuals seemed to come from a great distance too. Terns, however, we observed repeatedly feeding in the immediate environment. Adult specimens of *Sula dactylatra* and *Phaeton rubricauda* I never observed feeding, *Fregata minor* and adults of *Sula leucogaster* and *Sula sula* only a few times. Young boobies of all three species, chiefly birds too inexperienced to follow the adults, were observed fishing near the island nearly every day. Of course it is possible that the foraging far away from the brooding-colonies is only temporarily the case and may depend on direction and intensity of current and tide or weather-conditions.

Dr. Hardenberg, Chief of the „Laboratorium voor het onderzoek der zee" at Batavia, whose opinion I asked regarding this foraging at great distance, thought it possible that owing to particular circumstances certain sea-regions can be rich in fish while other in the neighbourhood lying zones are extremely poor.

He gives as an example an island of the outer Banda-bow, the west-coast of which proved to be full of birds with plenty of fish in the sea at that side, while along the east-coast practically no birds were seen and fishes also seemed to fail.

Beebe [1]) states about the foraging at great distance from the brooding-

[1]) "Galapagos: Worlds End". Putnam's Sons, New York 1924, p. 312.

grounds: "From dawn until seven o'clock dozens and dozens of flocks of boobies of two species came flying from the island directly toward and passed us, southwest, in the general direction of James. Remembering that the sea-birds of Daphne all flew due north every day, I realized that the intersection of the Tower and Daphne birds probably indicated an area of unusually good fishing ground, almost exactly on the equator and 90° 30′ west longitude. The same instinct which impels the Florida pelicans to go forty or fifty miles to their fishing grounds takes these birds far out to sea, while, as we were to sea later, individuals could find an abundance of food close at hand near their nests."

According to Bent (U.S. Nat. Mus. Bull. 121, 1922, p. 196) Snodgrass and Heller did similar observations concerning *Sula dactylatra* of the Galapagos Islands. The species was observed fishing at sea, 300 miles from the island and it is probable that the birds, in pursuit of food, daily travel more than 100 miles from their breeding grounds.

From my observations of the feeding of the young, of the disgorging of the food by the young and of stomach contents, it appeared that the food consists chiefly of cephalopods and flying fish. Observations were facilitated by the fact that the young of the big kinds emptied their crop like herons when we approached too near.

In regard to the feeding of *Sterna anaetheta* and *Sterna fuscata*, our observations were insufficient to warrant conclusions. **H.**

4. General remarks on systematics of Gg. Api birds.

The collections, made by Mr. Hoogerwerf during his stay in Gg. Api have given us not only a new subspecies, but have especially contributed to our knowledge of the juvenile plumage of different sea birds.

Particularly the material of *Anous stolidus pileatus* (Scop.) and *Fregata minor minor* (Gmel.) was found to be very important on this point. Unfortunately the material of the young of *Sterna anaetheta anaetheta* (Scop.) was too small to enable me to draw any conclusions, but it is not impossible that this species possesses a juvenile plumage, varying from that of its representatives in the western part of our Archipelago.

While identifying the material, a few points could not be explained, due to the fact that for a systematical research the series of a certain locality can never be large enough. Moreover our knowledge of the systematics of seabirds is often insufficient. This ignorance is ascribed to the universal distribution of these species and to the fact that no definite lines can be drawn between the various subspecies of these excellent flyers. In addition to this, each separate breeding-colony has its own characteristics, a matter to which I shall have to return later.

In general I have dealt separately with the various specimens in this collection, because the material was often not large enough to draw generalizing conclusions. Only in a few cases I have deviated from this method. This

precaution is the right thing to do, and I will make clear my contention with the following example. Two immature specimens of *Sula sula rubripes* (GOULD), (No. 9234 and No. 9235 in this collection), are about the same age. The colours of the plumage and the bare parts, however, are partly each other's conversion. If only one of the two animals had been collected and a conclusion had been drawn from that particular specimen with regard to the whole subspecies, we should have made a mistake.

It is hardly possible to draw any zoogeographical conclusions. Of the few races of land birds two are migrants (*Halcyon sancta sancta* VIG. & HORSF., *Coracina novaehollandiae melanops* LATH.); one is similar to the representative of the same "Rassenkreis" on Wetar, Kisar, Letti and Moa (*Zosterops palpebrosa lettiensis* FINSCH) and the other is a new subspecies of a "Rassenkreis" found both on Celebes and on Flores and bearing no special resemblance to either (*Hypotaenidea philippensis xerophila* nov. subspec.).

We have always to contend with a lack of literature and material for comparison in the Netherlands East Indies, and therefore I will not neglect to thank the following gentlemen for what they did to provide me with all the data I wanted:—

Mr. C. ANDERSON, (Australian Museum, Sydney);

Mr. F. N. CHASEN, (Raffles Museum, Singapore);

Prof. Dr. L. F. DE BEAUFORT and Dr. G. KRUSEMAN, (Zoölogisch Museum, Amsterdam;

Prof. Dr. H. BOSCHMA and Dr. G. C. A. JUNGE, (Rijks Museum Nat. Hist., Leiden).

Dr. M. BARTELS, (Soekaboemi). Lastly, I wish to express my sincere thanks to Miss A. C. W. VAN BEMMEL and Dr. N. J. FISSCHER (Hoorn) who translated my part of the manuscript. **v. B.**

Fregata minor minor (GMEL.).

Pelecanus minor **GMELIN. Syst. Nat. p. 572, 1789, Eastern part of the Indian Ocean (cf. ROTHSCHILD Nov. Zool. XXII, 1915, p. 145).**

Material:

Cat. Nos. Btzg. Mus.	Sex	Culmen	Bill from gape	Wing	Tail
13565	? pullus	27	38	—	—
9079	(♀) pullus	41	52	—	—
9080	? pullus	57	74	—	—
9081	♀ pullus	63,5	82	—	—
9082	(♂) pullus	68,5	89	—	—
9083	(♂) pullus	87	103	—	—
9084	♀ pullus	96	115	—	—
9085	(♂) juv.	93	110	410	247
9086	♀ juv.	95	110	470	306

Cat. Nos. Btzg. Mus.	Sex	Culmen	Bill from gape	Wing	Tail
9087	(♂) juv.	95	113	491	298
9088	♀ juv.	110	128	520	330
9089	♀ juv.	100	118	562	358
9090	♀ ad.	110	130	578	426
9091	♀ ad.	110	127	561	405
9092	♀ ad.	107	127	609	348
9093	♂ ad.	89	103	564	382
9094	♂ ad.	94	113	572	(370)
9095	♂ ad.	93	110	551	393
9096	♂ ad.	98,5	115	556	397

Number 13565 is a nestling of only a few days old and almost naked. The skin is light blue. On the head some rust-coloured down feathers (preplumules) are appearing, on the body some white ones. On the back and the wings the first black contour feathers make their appearance. Bill pink with dark tip, feet light blue. This is Phase I as described by Lowe (Nov. Zool. 36, 1931, p. 201) for *Fregata aquila* (L.).

The numbers 9079 - 9082 are nestlings of different age. Down all white, in the case of number 9079 the head is included. Of the three older specimens the down is light rust-coloured on the crown, under the eye and round the base of the bill. The two youngest birds have a group of black feathers on the back, at the left and at the right; the two older ones have already black blood quills in wings and tail. Iris dark-brown, feet light bluish grey, bill light bluish grey (of No. 9079 point of bill flesh-coloured; of No. 9080 the whole of the bill flesh-coloured). Bare throat bluish grey, orbital skin purplish.

Numbers 9083 and 9084 show a transition to the juvenile plumage. Forehead, crown and sides of head reddish brown. Underside, nape and shoulders all in white down covering, but back, wings and tail feathered. Wings have already the brown cross-bar of the adult covering. Iris dark brown, bill and feet light bluish grey.

Number 9084 has flesh-coloured feet, throat grey, orbital skin bluish grey.

The numbers 9085 - 9089 have the juvenile plumage, some specimens still with traces of white down. Head and nape ranging from very pale red to rust-coloured deep red.

A "rich cinnamon suffusion" of head, neck and breast is mentioned also by Bent (U.S. Nat. Mus. Bull. 121, 1922, p. 310) in "nearly every Pacific specimen", but as this author did not mention what species was meant, this statement is of little value.

The rust colour of the throat also covers a very small part of the breast and then changes into blackish brown. Number 9088 has a greyish brown zone between the red of the throat and the dark breast; Number 9089 has some reddish rust-coloured spots on dark breast. Belly clear white, undertailcoverts

black. All of them have a distinct brownish grey to pearl-grey wingband, the separate feathers of which have dark centres; iris dark brown, bill bluish grey, sometimes with a dark tip; feet ranging from bluish grey to flesh colour. Throat bluish grey, sometimes mingled with ochre. Two of the five birds are already fledged.

Of the adult ♀♀, Number 9091 has a violet and green glossed mantle, which is much less clearly visible on the other ♀♀. Of the adult ♂♂, number 9094 has a wingband which has the same colour as that of the adult ♀♀, in the other three specimens this wingband is very dark and slight. Mantle of number 9094 more green glossed and less violet than the others, and a much browner breast.

MEISE (Journ. f. Ornith. 78, 1930, p. 183) describes a similar specimen, which he considers a young bird which has not yet fully developed its colour. Number 9094, however, was found by a nest, containing one egg, so it had indeed attained to sexual maturity.

Adult ♀♀ have iris dark brown, bill flesh-coloured, feet bluish flesh-coloured, orbital skin red, throat flesh-coloured.

The adult ♂♂ have iris also dark brown, bill, however, black to deep grey, feet flesh-coloured to grey with deep grey toes and webs. The gular pouch ranging from flesh-coloured with light red spots to orange or vermilion. Orbital skin deep grey.

CHASEN and KLOSS gave to some specimens (originating from Boeroe) the name of *Fregata minor aldabrensis* MATH. (Journ. Mal. Br. Roy. As. Soc. II 1924, p. 65) but this was revoked by CHASEN himself (Bull. Raffl. Mus. 9, 1933, p. 73), after again examining the specimens in question.

The original determination was based on the supposed differences in colour between the subspecies *aldabrensis* and *minor*, which has been convincingly refuted by MEISE (l.c.). *Aldabrensis* is only distinguishable from *minor* by length of wings. This length is for *aldabrensis*: ♂♂ 585 - 606, ♀♀ 605, 621. The measures for *minor* are: ♂♂ 520 - 567, ♀♀ 561 - 599 (MEISE l.c. p. 184). The lengths of bills of both subspecies partly cover each other, the average length for *aldabrensis* being higher, namely: ♂♂ 116 - 130, ♀♀ 130 - 150 and for *minor*: ♂♂ 108 - 119, ♀♀ 127 - 133, 5 (MEISE l.c. and LOWE: Nov. Zool. 31, 1924, p. 307 - 308).

So the wing lengths ♂♂ 551 - 572, ♀♀ 561 - 609 and the bill-lengths ♂♂ 103 - 115, ♀♀ 127 - 130 of the Gg. Api birds fall within those of the subspecies *minor*. A specimen in the collection of the Buitenzorg Museum, from the surroundings of Bandoeng (W. Java), where it had evidently lost its way, has a wing length of 552, a bill length of 107 and therefore also belongs to the subspecies *minor*. v. B.

The Eggs.

In all cases examined by me the set consisted of one egg, which is entirely white. As in the *Sulidae* the egg is covered with a thin lime-layer but this is a matter of little importance. Even at the end of the incubation-period the

eggs are much cleaner than those of the boobies. In 29 eggs the length varied from 56.5 - 72.5 mm, and the width from 41 - 47 mm. The largest egg measured 72.5 : 47 mm. **H.**

Biology.

This species may be considered the most abundant of all bigger birds nesting at Gg. Api. As a rule the birds were quiet; they perched upon the nests or soared on their powerful wings in the air. At times I observed a whole flock of these birds hovering over the island seemingly not moving their wings, airily rising and descending at will without apparent effort.

Great dexterity and high speed were displayed when they tried to rob the returning tropic birds and boobies of their hard begotten catch. It is by this outstanding speed, developed in meeting and pursuing their victims, that *Fregata* finds itself rightly enlisted among the best flyers in the world. Many observers have expressed their admiration for the capacities of these phenomena of flight. Bent (U.S. Nat. Mus. Bull. 121, 1922, p. 312) formulated his respect of these ocean-dwellers in the following words: "The flight of the man-o'-war-bird is an inspiration; the admiring observer is spellbound with wonder as he beholds it and longs for the eloquence to describe it; but words are powerless to convey the impression that it creates. It is the most marvelous and most perfect flying machine that has ever been produced, with 7 or 8 feet of alar expance, supporting a four pound body, steered by a long scissor-like tail. It is not to be wondered as that such an aeroplane can float indefinitely in the lightest breeze".

Phaeton rubricauda particularly fell a victim to the robberies of the man-o'-war-birds. In most cases, any attempt to escape its pursuer fails, and the air-duel ends in a surrender of the wildly shrieking *Phaeton,* whose disgorged food is immediately devoured by the conqueror. During these pursuits I often saw *Fregata* revolving round its axis and once I noticed how *Phaeton* was caught by the leg and in this way was caused to a quick surrender. Once I saw the tropic-bird trying to escape by quick diving, but even then the man-o'-war did not leave him alone, and followed him to the ground. *Phaeton* plunged into the dead crater, but the man-o'-war-bird swooped down upon its victim that disgorged its food upon the ground. It was devoured immediately which was the end of the fight.

Though without exception *Phaeton* does its utmost to escape the pursuit, it hardly ever succeeds and usually the air-duel ends with the defeat of the loudly shrieking tropic-bird, spilling its meal to see it devoured by its pursuer. This shrieking louds like a shrill "keee-keee-keee" or "hieuw-hieuw-hieuw" or like a hard "huw-huw-huw".

Fregata seems to choose its victims well, as only a few times this manoeuvre proved to be fruitless. Not only the tropic-bird, but at times also *Sula leucogaster* and *Sula sula* fell a victim to these piratical ways. I never saw *S. dactylatra* bullied out of their food but of course chances are that it may occur once in a while.

The food disgorged during the flight is in most cases snatched away before reaching the ground or the surface of the water. In such cases where it fell upon the lavablocks, the food was left untouched by the pursuers. Not rarely *Fregata* competes one with another in these vile proceedings, and often one may see a free for all fight for their share of the loot.

WORCESTER (Philipp. Journ. Sc. VI. 1911, p. 174) remarks upon the robberies of the red-footed booby by the man-o'-war-birds as follows: "The frigate birds promptly formed a skirmish line and, singly or in pairs, attacked all comers, compelling them to give up their fish".

SHIRAS [1]) as well as CHAPMAN made similar observations; SHIRAS (p. 221) remarks: "At times they (the boobies) were intercepted in midair and compelled to disgorge for the benefit of the man-o'-war-bird. The diet of that hawk of the sea consists wholly of flying fish or the toll collected from the good natured boobies, the present of which makes certain a supply of fish for the young of its piratical neighbor". CHAPMAN in the same paper (p. 225) says: "Occasionally they chased the adult boobies and made them disgorge in the air, but evidently, in the main, they did their own purveying, flying fish being taken from one bird that was shot".

MURPHY (Natural History, Vol. XIV, 1939, p. 133) too points to the molesting of the victim and remarks: "Stubbornness on the part of a booby may lead to a torn neck or a dislocated leg; in the booby-colonies one can often find cripples that attest the wrath of the implacable tyrant", while WORCESTER (l.c. 174) writes about this matter: ".........but less experienced or more obstinate individuals which at first refused to disgorge were vigorously punished until they changed their minds and threw up their fish which were most adroitly caught in the air by their piratical enemies. In one instance two frigate birds set upon a booby, one of them attacking him from above and the other flying below to catch the fish which he dropped, and getting five out of seven".

Of *Fregata minor* I saw only a small number fishing near the breeding-grounds. Flying quite near the surface of the water they caught the prey with their powerful beak.

A study of the stomach-contents of some collected specimens proved that also at Gg. Api squids and flying fish form a considerable part of the diet of these birds. Occasionally also some gravel, in one case a big marble-round nut and other vegetable matter which could not be identified, were found.

I never saw a man-o'-war-bird alighting upon the water, a fact which seems also to be not or rarely observed by other naturalists. MURPHY (Natural History XIV, 1939, p. 143) comments upon this matter: "But although the man-o'-war-bird views the ocean all its days, it is meticulous to shun contact with its surface, because in the water this perfect glider is even worse off than when grounded. Once down indeed, it is a helpless, floundering monstrosity, incapable either of making headway with its puny feet or of lifting itself back into the security

[1]) **"Hunting wild life with camera and flashlight." Vol. II (Nat. Geograph. Mag. Washington).**

of the air. Worst of all its plumage quickly becomes waterlogged because the oil-gland above its tail is a minute, athrophied affair, totally insufficient for the waterproofing purpose that this organ fulfills for all other sea-fowl".

DELACOUR & JABOUILLE (Trav. Serv. Océanogr. Indochine 3e Mém. 1930, p. 20) mention the fact that *Fregata* rarely descends upon the water, never dives and always snatches the food from the surface. They mention the food of *Fregata minor* to consist of squids, crabs, flying fishes and young turtles.

As follows clearly from the above description of the birds in this paper, it is quite easy to distinguish both sexes. Moreover, during the mating season, the male bird can be recognized on sight in the open by a magnificent red- or orange coloured breast-pouch which in this period is often inflated to a big bladder, from 10 to 20 cm wide. Speaking about *Fregata aquila,* BEEBE (l.c. p. 316) remarks: "Eyes, beak and feet were dull, but out of this sombreness, like fire out of lava, billowed the burning scarlet of the enormous breast-pouch. When distended with air this was like a huge bladder, completely hiding the bird. Its distention was not dependent upon conscious muscular action for I saw birds quite sound asleep, with their beaks resting upon the top of this balloon as if on a pneumatic pillow".

Probably this breast-pouch plays a considerable part in the mating ceremony. A couple of times I saw the male bird cajoling the female to the nest or to the outlay for the nest, displaying this gorgeous bladder. The sequence of actions, as observed by me in one case at a place where a nest was to be built in a tree, may be described as follows. A male *Fregata minor* was perched at a height of some two meters in the outer foliage of a big *Pisonia* tree. The firy red breast-pouch was extended to a big balloon, in which the beak almost seemed to disappear. Sitting obliquely, the bird rocked head and neck to and fro, clattering its beak uttering a jodeling sound like "kleeew—— leeew—— leeew——" or "leeew—— leeew—— leeew". Now and again the bird flapped its wings. This "rite" obviously was intended for the female bird, hovering above the nest, as the male followed her in all her movements. The action reached a climax as she swooped down upon the nest and both birds flapped wildly their wings.

The female bird caressed the inflated breast-pouch with the beak, and now and then catched eagerly the other's bill. At the time no copulation followed this move. Next day I saw the male bird again perching at the same spot. This time it kept quiet, with breastpouch inflated. After some more days the birds were building their nest here, so this seemed another reason to consider the described behaviour as coinciding with mating.

A similar description has been given upon this matter by MURPHY (l.c. p. 134). He writes: "During the breeding season this (the breast-pouch) is inflated by a series of pumping, gulping actions until it attains the size and appearance of a red toy balloon. It is then the love-banner which produces the requisite excitement in the female, who alights at the tangled tops of shrubbery or swamp trees that the male has chosen for a nest. Both birds next

assume a backward leaning posture, face to face, raise their bills, allow their wings to droop limply, wave the head and roll the bodies exstatically while emitting incoherent gurgling and chuckling noises. At the same time the pointed iridescent feathers on the back stand up like bristles and the lovers swell and tremble with an amorous ador, of which the gorgeous red globe of the male is the most striking symbol".

Also Beebe (l.c. p. 317) makes a note on a similar ritual by *Fregata aquila:* "Then another emotion obsessed him; he bent his head back until it sank between its shoulders the red balloon projecting straight upward, and the long angular wings spread flat over the surrounding bushes. The entire body rolled from side to side, as if in agony, while the apparently dying bird gave vent to a remarkably sweet series of notes, as liquid as the distant dry of a loon, as resonent as that of an owl. In our human inadequate, verbal vocality, I can only record it as kew-kew-kew-kew-kew-kew! In a higher tone the female answered him from the sky "oo-oo-oo-oo-oo!" and: "for a few minutes, the birds sat close together, going through various forms of dying ecstasies".

In a note on *Fregata* (Bull. Raffles Mus. 14, 1938 p. 47) Wetmore gives some particulars about the breast-pouch of the male *Fregata*. He remarks to this point: "While I am not familiar with this species (*F. andrewsi*) I do know quite well the males of *F. magnificens* and *F. minor strumosa*. In these the gular pouch is large and brilliant red in color, during the nesting season when it is displayed prominently. Males are attentive to the nest and undertake much of the work of incubation when the egg has been laid. As soon as this stage in the breeding is reached there is no longer display of the gular pouch which immediately begins to shrink in size and to change to a dull orange in colour. In a short time it can no longer be inflated to prominent size as I have demonstrated with a blow pipe on freshly killed individuals".

In this connection it seems of sufficient importance to stress that at Gg. Api several times I observed frigate birds with inflated gular pouch, which instead of its ordinary bright red colour showed a dull orange or still a paler tint; so it is likely that in *Fregata minor minor* the shrinking of the breast-pouch does not go parallel with the fading of the colour.

A great number of frigate birds found by me at Gg. Api had eggs and chicks. Freshly laid clutches as well as numerous young birds of almost all ages were observed.

The nests were built in different trees at very variable height above the ground. Few only were located at a height of from 1 to 2 metres, others about 8 to 10 metres up the trees, whereas most buildings were observed at a height of 3 to 6 metres. The nests are built in the dense foliage of the coarse-leaved *Pisonia sylvestris* as well as in the almost leafless *Ficus* and *Terminalia* trees, which at the period of my stay at the island shed their leaves. They seemed to show a marked preference for the small and sparcely leaved *Ficus* trees. At some of the steepest slopes, i.c. along the wall of the crater, I observed many nests built in the small *Ficus* shrubs. About the nesting places of *Fregata minor*,

Delacour & Jabouille observe (l.c. p. 20): "Leurs roqueries sont en général placées sur les ilots coralliens, isolés, couverts de vegetation, d'arbres le plus souvent. Celle de l'isle Adèle, au N.O. de l'Australie, est couverte de l'Ipomoea, sur lesquels les nids forment de veritables grappes, variant de cinq à six jusqu'á vingt".

The necessary material is probably stolen for the greater part from the nests of confraters. The material that is not acquired in this way is most likely snatched from trees and shrubs in passing flight. About the nest-building Murphy (l.c. 134) remarks:

"Ordinarily the twigs are snapped off in passing flight from the tips of dead branches, or are filched from the red-footed boobies — the only species of its kind which uses wood or build upon the ground — while they are carrying them homeward for their own domestic purpose".

And further: "Both birds of a pair take part in nest-building, the female toting lumber while the male, with his rubber throat blown up, squats on the platform under construction, arranges the incoming sticks, and what is more important, protect them against pilfering by strange females. He dares not leave his post at this critical juncture because 'finding is keeping' is the morality of the tribe. Sisters, aunts and other men's wives swoop down on an unguarded nest and purloin every vestige within a twinkling".

At Gg. Api the nests consisted of small twigs and rarely exceeded in size those of the smaller heron-species, i.c. *Ardeola speciosa, Demigretta sacra, Egretta garzetta,* etc. They were as a rule so flimsy that one could observe the beautiful white egg through the twigs. The small care, given to the nest, may be the cause that rarely a young bird older than three weeks is found upon a nest. At that time only few twigs at the most, are left of this structure, more often even less and generally the nest has disappeared altogether. Murphy (l.c. p. 134) as well as Delacour & Jabouille (l.c. p. 20), contrary to my observations, write how the structure is reinforced by the droppings of the young birds.

According to my observations both sexes have an equal share in the task of brooding, a fact which neither agrees with Murphy's notes which run as follows: ".........but, from beginning to end, the major share of housebuilding, incubation, and guarding of the young seems to fall to the lot of the hen-pecked father".

After my experience the nest never contains more than one egg, and is not left alone for a moment. On our visit, which seemed to disturb the birds, it occurred that some frigate birds turned up to steal material from abandoned nests, thus wrecking the clutch. Once at a distance of about ten meters, I observed a male bird alighting upon such a deserted nest, taking the egg in its beak and smashing it upon the lava blocks! In this particular case however, the nest was not demolished, but the intruder sat down until the female bird chased him and recovered its seat on the plundered nest. A flowery description of such a nest-robbery is given by Beebe (l.c. p. 316): "........., and instantly

there came a metallic twang of pinions — a loud wonk! wonk! — and another frigatebird swooped, caught up a twig, and as a polo-player at full gallop swings at a ball, so the bird reached, plucked, and was off. Another and another followed, and before the owner returned a half dozen sticks had been purloined by its neighbors. Down on the rumpled nest sank the first bird and began rearranging the ruins".

Next observations do not at least agree with those done by me. DELACOUR & JABOUILLE remark: "A l'Ile Adèle c'est à peine si elles poussaient quelques cris à l'approche de naturalistes et ne s'envolaient que s'ils étaient a moins de deux metres. Pour obtenir les oeufs, ils furent plusieurs fois obligés de pousser la couveuse en dehors du nid" (l.c. p. 20).

At Gg. Api this species was rather shy and it was by no means possible to approach the breeding birds at such a short distance as these authors state.

During the first days of their life, the young birds are sheltered continuously. This may be regarded as a precaution against marauding of nest material and death to the young by sunburn, not so much as a precaution against murderous pirates endeavouring to kill them.

BAILEY (vide BENT l.c. 308), referring to the effect of death by sunburn at the west coast of Mexico, remarked that it did not take the hot sun a long time to kill any small young [of *Fregata magnificens rothschildi*] that the parents left unsheltered for even a few moments.

The call of *Fregata,* circling above the nest and young, sounds like "chee-chee-chee", or "keeew-keeew", while perched on the nest it rings like "ow-ow .... kô-kô-kô". The young respond by a "chee-eee-eet ...... chee-eee-eet", begging with bowed head and fluttering wings. The bigger chicks, which pass a great part of the day upon the nest or at the place where this has been, produced, apart from a sound which may be compared with "kee-ee-eeuw ...... kee-ee-eeuw" another croaking cry when an adult bird came near.

Not always the chicks responded to the presence of older birds and on the other hand the young "begged" rather frequently at the approach of a strange bird. From this I conclude that not always the parents are recognized by their young.

The food is pecked by the young from the beak and throat of the parents with as much ado as in the case of boobies, and with as many apparently unnecessary movements.

This complex of action ordinarily completes itself in a short time, immediately after the parent has alighted near the young bird. After this the old birds perch at a safe distance from the young or disappear altogether.

As mentioned above the big young birds often sat upon the trees, devoid of nest material. I got the impression that they nearly never moved from the spot where originally the nest was built. They probably keep there till they are able to fly. Even our approach did not cause them to move from their place; they only snapped at the intruder with a clattering sound of the powerful beak in the direction of the assault.

From my observation on the development of the young I presume that they are able to fly at an age of about 10 to 12 weeks.

A couple of young birds taken along with us, are now kept at the Batavia Zoo and still are in a good condition. Their diet is seafish. The birds snatch the food thrown at them by the guards from midair, waiting placidly till it is within easy reach and never move to meet it. Also they never pick it from the ground or out of the basin. At this time — after about two and a half years of captivity — these specimens do not differ considerably from those shown on pl. 32 fig. 2 & 3 fourth from left. There is, of course, no definite proof that they would be identical with those grown up in their natural environment. The birds never get any excercise, though they are housed in a spacious cage. Moreover, it may be that the diet differs somewhat from that of the birds living in a state of nature. These two conditions may effect the colouring of the plumage. **H.**

Sula sula rubripes GOULD.

Sula rubripes **GOULD, Syn. Birds, Australia pt. IV.1838 App. p. 7 Terra typica, Australia.**

Material:

Cat. Nos. Btzg. Mus.	Sex	Culmen	Bill from gape	Wing	Tail
9228	♀ pullus	46	61	—	—
9229	♂ pullus	77	93,5	—	—
9230	(♀) pullus	77	96	290	210
9231	♂ pullus	77	96	328	210
9232	♀ juv.	79	98	375	221
9233	♀ juv.	81	103	378	221
9234	(♀) juv.	84	105	375	221
9235	♀ ad.	(83)	(103)	376	223
9236	♂ ad.	77	96	355	226

Number 9228: pullus in clear white down. Iris deep grey, bill black, feet light ochre coloured. Orbital skin black, rest of head light blue with deep grey spots. Numbers 9229 and 9230 both nestlings in white down, but feathers on back and tail greyish brown. Wingcoverts in same colour, quill-feathers dark brown with a silvery gloss. Iris grey, bill black, feet light ochre coloured, head dark grey, near throat light blue with grey spots. Number 9231 entirely greyish brown, head, wings, breast and neck are still wearing traces of down. Quill-feathers greyish brown with silvery reflection. Iris light grey, bill black, feet light ochre coloured and skin of head dark grey. Number 9232 a juvenile animal in brown plumage. Forehead still with traces of down. Colours of bare parts resembling the last specimen, but feet are light flesh-coloured.

Number 9234 and 9235 have a spotted transitional covering. Back and tail of one animal are white, of the other greyish-brown with white spots. Belly

white, one has breast dusty grey white, the other clear white. Head and neck light yellowish grey, shoulders and wing coverts greyish brown with white spots, quill-feathers dark-brown with silvery reflection. The change to adult plumage is evidently rather irregular, for, all that is white in one bird is brown in the other and conversely. Of one adult the iris is still light grey and of the other the iris is already dark brown. The latter, however, has pale feet and a pale bill, whereas the former already has a blue bill and brick-red feet. Head purple round the eye and light red to greenish on cheeks, throat bluish grey.

In both adults the eyelid is light blue, throat grey. Iris dark brown, bill light blue, feet light crimson with light blue nails. So the statement of Mr. TWEEDIE (CHASEN: Bull. Raffl. Museum, 9, 1933, p. 65) as to the colour of eye in adults is hereby confirmed; it is remarkable that one of the spotted immature birds has already dark brown eyes. The bare skin on the head of adults is less coloured than stated by Mr. CHASEN for birds of Christmas Island. The heads of the variegated animals on the contrary are very pied. CHASEN (l.c.) drew the attention to the fact, that in reality juveniles of this species (still showing traces of down) are already full-grown and their measurements tally with those of the adults.

The birds of Gg. Api are considerably smaller than those of Christmas Island, but they have a longer tail. Nevertheless it seems incorrect to me to separate the Gg. Api birds from *rubripes* on this account.

In order to do justice to each particular breeding colony, it should be given a separate subspecifical value. However this method would entail an endless splitting up of species in a great number of races and this again would have a confusing rather than a clarifying effect. As long as we do not have exact data on the subject whether members of various colonies occasionally intermingle or not, there is no foundation to recommend the above mentioned suggestion. This is a matter, in which the experiment ought to assist systematics.

This also applies to what will be said below about *Sula leucogaster*. **v. B.**

The Eggs.

Several dozens of nests examined contained only one egg, which, like the egg of *Sula dactylatra,* is coloured a fine bluish-green, the lime-layer being usually much thinner. The eggs are much cleaner, the spots in some eggs are probably caused by the contact with the moist leaves of the nest, the birds never alighting on the ground and therefore not soiling their legs or body so much. In 15 eggs the length varied from 57 - 67 mm and the width from 36 - 41 mm. The longest and widest eggs measured 67: 37 and 58: 41 mm, respectively.

H.

Biology.

Contrary to the two other kinds of *Sula* described in this paper elsewhere I observed the red-footed booby at Gg. Api only living and nesting in the

trees. By its peculiar voice and behaviour under certain circumstances, this small *Sula* reminded me more of a cormorant than of a real booby.

The number of birds observed was considerable and amounted probably to several hundreds. At twilight we saw the greatest number when the birds returned to their roast on the volcano; among them we saw full coloured adults as well as young birds with a rather great difference of age and feathering. Permanent resting-places, such as some almost bare *Ficus* trees on the western slope, contained many scores of red-footed boobies, a short time before dusk.

The nests occurred almost without exception at the outside of the main vegetation, or in solitary trees of *Pisonia,* as well as in *Ficus* and *Terminalia,* generally some 3 to 6 meters above the ground. Notwithstanding the fact that in one tree several nests of one species may be found, a marked tendency to this was not apparent. The nest resembles closely the nest of the little cormorant (*Haliëtor niger* VIEILLOT), but it is much bigger; it is built from fresh twigs, in many cases still bearing the leaves, with, as a rule, many leaves in the nest-hole too.

DELACOUR & JABOUILLE (Trav. Serv. Océan. Indochine, 1930, 3e Mém. p. 17) and TWEEDIE (Bull. Raffl. Mus. 8, 1933, p. 66) also report this booby to breed in trees and shrubs. WORCESTER (Philipp. Journ. Sc. VI. 1911, p. 169) mentions the red- footed booby's aptness for stealing the material from the nests of *Sula leucogaster* and of its own kindred, and the birds' wildly pursuing one another in flight to recover the loot.

At Gg. Api all clutches only contained one egg, and were incubated by both sexes; no difference could be observed in the part of this work for either of the birds. Relieve of the guard is often accompanied by a "greeting ceremony". The newly arriving bird sags to the nest and produces with lifted beak and retracted neck a shrill sound, like "akkè—— tjètjètjètjètjè".

When alighting upon the trees, even if no nests or other birds occurred there, often a cry was heard sounding like "ku-ku-ku-ku-ku" or "kjeè-kjeè-kjeè".

A similar behaviour was noted by BEEBE (Galapagos 1924 p. 321) for *Sula sula websteri.* He writes: "The voices of the boobies were harsh, a series of raucous squawks like a whirling rattle. The bird on the nest greeted his mate with an outcry registering joy which for a moment outsounded the whole colony".

According to BENT (U.S. Nat. Mus. Bull. 121, 1922 p. 214) GIFFORD has reported the following concerning the greeting-ceremony of a related subspecies: "When a bird alighted at its nest or beside its mate it craned its neck and, swinging its head from side to side, uttered a long, harsh, cackling call consisting of a short guttural note repeated fifteen or twenty times in quick succession".

Often I heard the birds roosted on the nest utter a crackling sound, which may be represented by "krrrrrrrrrèh... krrrrrrrrèh" or a rattling, much prolonged cry like "karrrrrrrrr... karrrrrrrrr". The beak was not opened while uttering these and similar sounds. About this matter BEEBE (l.c. p. 320) remarks on *Sula sula websteri:* "Even with its pouch full of fish, and a green-leaved twig in its beak, it could scream its rage loudly at being attacked".

CAMPBELL (BENT, l.c. p. 212) points out that the incubation period of the egg lasts 45 days.

The young emerge from the egg naked, but after a few days they are covered with a beautiful white down. After two or three weeks feathers grow. Probably the young will leave the nests at the age of 10 or 12 weeks. I could not obtain data on the time required for the adult plumage to develop.

Feeding the young shows also more resemblance to what is known of the *Phalacrocoracidae* than to that of the other species of the *Sulidae*. I got the impression, that the bill of the young bird was forced considerably deeper into the throat of the parent as is the case with *S. dactylatra* and *S. leucogaster*.

The fishing-grounds of this booby, just like that of *Sula leucogaster*, seem to lie at some distance from Gg. Api. The young birds and the rare adult ones, which I saw fishing near the island in company with juvenile and adult *S. leucogaster* and the young of *Sula dactylatra*, caught their prey by thrusting their head under the surface of the water while floating about. Never I saw the birds immerse completely, as has been reported a habit in this species. In the stomachs of some of the specimens collected at Gg. Api a nut and remains of squids were found. To this point and to the matter of food MURPHY (Nat. Geogr. Mag. 74, 1938 p. 248) remarks: "This species feeds upon fish and probably still more on squids. It usually flies far beyond the broken water of its own island shores, seeking an area of peaceful Ocean swell where flying fish break the surface and where squids approach when the sky darkens" and: "The birds ordinarily plunge into the sea from a height of thirty feet or more for their prey, but sometimes catch flying fish in the air when they have been driven from the sea by predators frow below".

DELACOUR & JABOUILLE (l.c. p. 17) state how these birds catch fish by plunging, often from a considerable height into the water, causing thereby sometimes the death of the bird on the submerged cliffs. **H.**

Sula leucogaster plotus (FORST.).

Pelecanus plotus **FORSTER. Descr. Anim. ed. Licht., 1844 p. 278: near New Caledonia.**

Material:

Cat. Nos. Btzg. Mus.	Sex	Culmen	Bill from gape	Wing	Tail
9220	♂ juv./ad.	98	119	385	205
9221	♀ ad.	102	122	405	182
9222	♂ ad.	97	115	395	218
9223	(♀) pullus	91	110	300	165
9224	♀ juv.	—	—	330	165
9225	♀ juv.	92	110	393	201

The youngest bird in this series is Number 9223, a pullus for the greater part still in down covering. Tail, wings and back have dark brown feathers. Breast developing a crown of dark brown feathers, the rest of underpart covered

with dusty white feathers with light brownish grey tops mingled with white down.

Rest of body covered with white down. Iris light grey, bill light bluish grey, ridge of bill with umber coloured spots. Feet ochre coloured, throat flesh-coloured.

The two other juveniles (number 9224 and 9225) are already entirely feathered. One has a dusty white to light grey underpart, near the dark brown breast changing into brownish grey, the other has an almost completely brown underpart, the feathers of the belly having a white base and white tops. The semi-adult ♂ (number 9220) has a sooty white belly, the separate feathers of which have light brownish grey tops. So the colour of the belly-side is evidently rather variable in juveniles. The back uniform dark brown just as the other adults. Iris varying from dark brown to light grey. Bill light bluish grey. Feet ochre coloured, throat light bluish grey. Full grown animals have a light grey iris, greyish green bill; yellowish green feet and dark bluish grey throat. Orbital skin green. Sex-differences could not be found.

About the subspecifical division of this species we are still in the dark. Robinson & Kinnear (Bull. British Ornith. Club. 48, 1928, p. 64) give a table in which measurements of forms of this species from the Atlantic, Pacific and Indian Ocean are compared. They state that the differences are slight and moreover the several breeding-colonies of a subspecies are mutually varying. Chasen (Bull. Raffl. Museum VIII, 1933, p. 67) reckons *Sula leucogaster* of Christmas Island among the subspecies *rogersi* Matth., though with some reserve. In his "Handlist", however, he mentions Christmas Island as part of the area of distribution of *plotus* (Forst.). J. L. Peters in his "Checklist of Birds of the World" considered *rogersi* as "probably the same as *plotus*".

The series of Goenoeng Api is too small to give sufficient information about the subspecifical place. The few measurements fall within the average both of those given by Robinson & Kinnear (l.c.) for Indian Ocean birds and those from the Pacific, except the culmen of the adult ♂ which would point to the last.

For purposes of comparison I mention here some measurements of *Sula leucogaster*, taken from birds of other localities.

	Cat. Nos. Btzg. Mus.	Sex	Culmen	Bill from gape	Wing	Tail
Boeroe:	9218	♂	90	109	375	207
Isl. Middelburg (W. Java)	9219	♀	100	119	385	—
Noesa Baroeng (E. Java)	12476	♀	100	118	402	215
Strait of Malacca	12477	♂	87	102	272	205
Etnabaai (S. New Guinea)	Leiden Mus. Exp. K.N.A.G. 1939 No. 0129	♂	97	113	381	217

The bird of Boeroe (see also SIEBERS: Treubia VII, Suppl. livr. 5, 1930, p. 219), is strikingly small and is within the limits of Indian Ocean birds. The New Guinea bird fully agrees with those of Gg. Api.

The difference between the two birds of Java and those of Gg. Api is very slight. On the other hand the bird of the Straits of Malacca is so very small, that it can only belong to the Indian Ocean group (cf. CHASEN, l.c.).

So long as there is thrown no light upon the systematics of this species by a close examination of large series of the whole area of distribution, it seems better to me not to suggest new subspecies, though it is obvious that in the long run the maintenance of a single subspecies for the East Indian Archipelago will appear impossible.

I used here the name *plotus* following CHASEN. Shortly after I had completed this paper Mr. CHASEN wrote me as follows:

"When I examined all the material in the British Museum and in Tring some years ago, I could not separate any form that was likely to be *rogersi* and if any new subspecies is required it would seem to be wanted for the Indian Ocean birds. Almost every breeding colony could be separated on some difference or other but we seem here to pass from the realm of practical systematics into that of biometrics, or even pure mathematics!

The final conclusion I came to was that the most reasonable course was to regard all our birds as *plotus*, within the range of which numerous "local strains" have developed, which are impossible to isolate in a satisfactory manner because birds from far away colonies will diverge in the same way. I think that in Malaysia we have two "kinds" of *Sula leucogaster*, but until some systematist working on a very large collection tells us more about the subspecies, I regard these both as *plotus*, but from different breeding colonies". **v. B.**

The Eggs.

Since I could not find a single egg of this species, I have to refer to information contained in literature concerning species of the same kind found brooding elsewhere.

MURPHY (Bull. Am. Mus. N.H. 1, 1924, p. 253) tells us that the clutch usually consists of three eggs, laid at a considerable interval of time.

About the size of the clutch BENT (Bull. U.S. Nat. Mus. 121, 1922, p. 203) remarks: "From the foregoing quotations it would seem as if two eggs was the normal set with the common booby (*Sula leucogaster*) but apparently sometimes only one egg is laid."

In 30 eggs collected on the island Raze of the Cape Verd Archipelago, CORREIA (in MURPHY, l.c. p. 253) gives the following measurements: Length varying from 53 - 64 mm, width varying from 37 - 43.5 mm. They resembled those of the other species of booby, though showing more variation in size and shape.

In 40 eggs belonging to the collections of the United States National Museum and his own, BENT (l.c. p. 204) gives the following average measurements:

59.4: 40.2 mm. Maximum: 65.5: 41 and 62: 42.5 mm; minimum: 52.5: 40 and 56.5: 34.5 mm.

Delacour & Jabouille (l.c. p. 18) mention about the egg: "Les oeufs qui resemblent à ceux des autres Fous, sont d' un blanc verdâtre et couverts d' une mince couche de chaux. Suivant les roqueries, ils varient de 68: 46 à 61: 41 mm. Leur nombre est invariablement de deux, qui occupent la faible dépression qui se trouve au milieu d'un nid presque plat."

Mr. M. W. F. Tweedie, on Christmas Island, Sept. 17, 1933, found two eggs of *Sula leucogaster ? rogersi*, one of which contained a large embryo. These eggs measured 62.8: 41.5 and 64.6: 41.8. Besides, Tweedie saw a young bird in down feathers, on 18th September (cf. Chasen, l.c. p. 67).

Biology.

Neither sets of eggs nor very young chicks of this species were observed. The occurrence of a great number of fully fledged young birds and two young ones, of approx. 4 or 5 weeks old (partly in down), justifies the supposition that Gg. Api is also the breeding-ground of these birds.

Though the birds seem very shy when not breeding, — as we could confirm a year later at the steep slopes of Noesa Baroeng, an island off the South-coast of East Java, — they seem to meet man as fearless as the other members of this family when breeding. To this point Chapman (quoted after Bent U.S. Nat. Mus. Bull. 121, 1922 p. 204) remarks: "When perched on rocks about the border of the island, boobies showed a decided fear of man and generally flew before one had approached to within 30 yards of them; but once on their nests they were conspicuously tame, the degree of tameness being related to the advance of the nesting season".

The number of adult birds that occurred during daytime at the island was rather small. In the late afternoon, however, their number increased considerably and amounted to several hundreds at twilight. The greater part of the boobies perched on the small *Ficus*-trees, growing on one of the steepest western slopes of the mountain, where they passed the night. In this respect they behaved quite differently from the big booby *Sula dactylatra*, which I never saw perching in trees and shrubs or about these steep slopes.

Sometimes, I found the birds in the dense *Pisonia* wood, which covers the mountain for a great part. The two small young mentioned above were found in this wood and fed there by the adult ones.

Here, too, I found the only nest of this species on the barren soil. It consisted of a number of dead twigs, leaves and mouldy wood, in the nestbowl were some green leaves; it measured ± 50 cm in diameter and had been built against a ± 75 cm thick *Pisonia*-tree. An adult bird was perched on the nest as we first saw it, but later on we found it deserted. Therefore I am not absolutely sure that the nest actually belonged to this species, but I am inclined to consider it as such as no other bird would have built it in that place and because the

material resembled that mentioned by WORCESTER for the species (Philipp. Journ. Sc. VI, 1911 p. 169).

This author also observed twigs with fresh green leaves together with dead twigs and mouldy wood. As I did not find any other trace of old and deserted nests in this environment and the majority of the adult birds and young ones also were seen at open spaces, I presume that at Gg. Api as a rule *Sula leucogaster* does not nest between the vegetation.

Although this booby cannot so easily take wing from the grassfloor or lower shrubs, the fact remains that they attain a remarkable dexterity in flying up from the ground in the wood and between trees, which observations are confirmed by WORCESTER (l.c. p. 170). The same author states (l.c. p. 169) that the twigs are picked by the birds from the trees. Ordinarily the male birds carry the material to the nest where it is received by the female. Moreover, he observed that sometimes this material was thrown away and that assistance in the building of the nest by the male was not appreciated at all, which WORCESTER deducted from the fact that the material applied to the nest by the partner was removed by the female.

This author also mentions (l.c. p. 172) *Sula leucogaster* to nest and breed in shallow holes in the sand where no other nesting material was available than some decomposed driftwood. Once a bird of this kind was found to have made a hole into a log of wood into which the two eggs were deposited.

WORCESTER (l.c. p. 169) mentions furthermore that in many cases the nests were built close together and that the male birds were continually stealing nesting material from another's nests, which caused the different occupants to combat one another fiercely. He was unable to state if the birds were wounded in these fights. According to MURPHY (Bull. Am. Mus. N.H. I, 1924, p. 253), CORREIA writes: "The booby seems to be absolutely indiscriminate in the choice of a nest, any haphazard site will serve, and no building materials are used". This same author, citing ALEXANDER (Ibid., p. 252) tells how the birds deposit their eggs at the level ridges of steep rocky slopes of the seacoast, where a little soil had accumulated. The nests were scarcely 2 feet apart and consisted of a shallow hole, surrounded by some pebbles and rocky scales. At variance with all other authors consulted, DELACOUR & JABOUILLE (Trav. Serv. Océan. Indochine, 1930 3e Mém., p. 19) remark about nest-building: "Celui-ci se trouve de préférence sur les buissons ou sur les basses branches d'arbustes; il n'y a que lorsque ceux-ci manquent, que les Fous font leur nid sur l'herbe". AUDUBON (vide BENT l.c. p. 201) mentions also that the birds breed in trees in big nests, which probably are used many years in succession.

This statement has been considered by later authors as based on faulty observation. BENT, however, is inclined to believe it, as AUDUBON actually collected many specimens of *Sula leucogaster* at the breeding-place and, moreover, the breeding of this bird in trees has been reported by other authors.

According to Worcester (l.c. p. 170) the female *Sula leucogaster* is unwilling to leave the nest in which the eggs are laid and as a rule will do so only if she is pushed aside forcibly. Often the birds show a remarkable courage in defending the clutch, picking at the hand which is stretched out to the nest. Moreover, the nervous behaviour of these birds is noted in case man approaches the nest. Then the nesting material is removed and readjusted.

Murphy (Bull. Am. Mus. N.H. I, 1924, p. 252) points to the irregularities which can be observed in the depositing of the eggs and to the fact that throughout the year newly laid eggs and young birds may be found. This statement is supported by similar observations by Correia. After Murphy (Ibid. p. 253) Correia seems surprised that eggs as well as chicks in all stages of development may be observed at the same time. Local fishermen told him, that eggs as well as young birds were common throughout all seasons.

The same observer relates that the young are hatched naked and are carefully guarded by the adults to prevent sunburn and that, not until after two weeks, they are covered by a snow-white down. Most probably this will be the case at a much earlier age. Murphy (Nat. Geogr. Mag. 74, 1938 p. 248) remarks that the down grows very soon, while I observed in *S. sula*, that the down appears within a couple of days after the young has been hatched.

At an age of 3 to 4 weeks the young present a marked resemblance to those of the bigger *S. dactylatra;* at a later stage, however, this resemblance vanishes. Concerning the time in which the young *S. leucogaster* grows self-supporting, Chapman (vide Bent l.c. p. 205) remarks: "Evidently but one is reared, since approximately three months must elapse after the egg is laid before the young can fly and care for itself".

In this species too I never saw that 2 young were fed by one and the same parent. It does not seem probable, however, that the set will consist of one egg only, considering that this and other races of the same species, breeding elsewhere produce 2 or 3 eggs. The reason for the lack of one or two young in those nests may be the same as presumed for *S. dactylatra* (vide postea).

Murphy (Nat. Geogr. Mag. 74, 1938, p. 248) remarks that 2 or 3 eggs are deposited but that, as a rule, only one young is reared. Concerning this unequal development of the eggs of the same set, Chapman has remarked about *S. leucogaster* of the Bahama Islands (cited after Bent l.c. 202; compare also the notes about *S. dactylatra*): "Examination of the eggs contained in sets of two showed that either there was a marked difference in the development of the embryos or that one or both eggs were infertile. For example, of 13 nests containing 2 eggs, in 3 nests both were bad; in 10 both were good, but with every good pair there was about a week's difference in the age of the embryo. In 6 nests, each containing one young and one egg, 5 of the eggs were decomposed".

The following remarks of Correia (Murphy, ibid., p. 253) are interesting:

"In examining a set in one nest I observed that a chick was about ready to break the shell of one, while the second egg contained only a small embryo, and the third was so fresh that it might have been eaten. Again I saw three chicks in a nest, one so large as to be able take care of itself, the second capable of lifting its head only with difficulty, and the last emerging from the eggshell. Such incidents led me to believe that there is normally a period of many days between the deposition of the eggs".

The feeding proceeds in the same way as will be described for *S. dactylatra.* MURPHY (l.c. p. 253), citing CORREIA, writes: "They carry fish in their crops to the young, and the latter cause great confusion by their outcries and their efforts to introduce all their heads together into the mouth of the parent. The old birds however, calmly let the chicks tire themselves out before responding".

About the food furnished to the young, CHAPMAN (vide SHIRAS) remarks: "The young feed on squids and fishes, which in a more or less digested condition they obtain by thrusting their heads and necks down their parents' throats".

At Gg. Api the food consists principally of cuttlefish and flying fishes. The young birds repeatedly disgorged entire flying fish, among which I noted some measuring 25 cm.

Often I saw *Sula leucogaster* fishing in flocks near the island. Among these not only old and young specimens of *Sula leucogaster* were observed, but *Sula sula* also. Not once I saw the birds immerging completely. Head and throat were thrust into the water and the catch was gorged above the surface.

According to CORREIA (vide BENT l.c. p. 253) *S. leucogaster,* in hunting for food, plunges 5 to 6 feet deep into the water. In the stomachs of the birds, collected by him, have been observed herring, flying fish, needle fish, etc. The birds should prey until dusk, and perch on the rocks at night.

MURPHY, citing ALEXANDER (Bull. Am. Mus. N.H. I, 1924, p. 251) mentions that this booby hunts singly as well as in flocks of 15 to 20 birds. His description of the preying may follow here: "The dexterity with which the species catches its prey must be seen to be appreciated. As soon as the fish is sighted, the bird, with closed wing, shoots into the water, the next moment to reappear floating on the surface busy tackling its prey and looking for an instant like a bird mortally wounded. Sometimes however, a series of rapid twists and turns are indulged in prior to the dive, some 20 feet above the water. These movements may either result from the presence of a shoal of fish, the sight of which causes the bird to waver in its choice, or to a single fish having altered its course".

With regard to foraging, MURPHY (Nat. Geogr. Mag. 74, 1938, p. 248) tells furthermore: "It is a businesslike fisherman, doing much of its plunging just outside the breakers of its home-island, varying its altitude according to the depth at which fish are moving and keeping for its own sustenance whatever the man'o' war bird does not subsequently steal". And CHAPMAN (vide SHIRAS p. 225) writes: "The boobies are rather heavy bodied birds, but go far to

sea in search of fish and have the power to soar or glide long distances on set wings"; and further: "Boobies usually fish against the wind, flying low over the water and entering it in full flight at an acute angle and coming out at a similar angle still in full flight against the wind, some 30 to 40 yards beyond. While submerged they appear to fly as they do in the air".

A remark of Murphy points to the possibility that *S. leucogaster* probably fishes at night too. He says (Nat. Geogr. Mag. 74, 1938, p. 248): "The depredations of the man' o' war birds cause the boobies to return to their island later than most sea-birds, even after their enemy has gone to roost. At times likewise they do some of their fishing at night".

I can not give any data upon this matter because I have not been able to make any observations at night.

We observed a great many dead and emaciated birds. As they were all young, full-fledged or almost full-fledged birds, the assumption seems to hold that they failed to find the sea and perished by lack of food. Apparently, a part of the adult birds desert their bigger young, leaving them too early to their fate. I was able to observe some of these birds, which were in an extremely bad condition for a couple of days; not once I saw them fed. After some days of starving they died with completely empty stomach.

Beebe observed similar conditions at the Galapagos Islands for *S. nebouxi* breeding there. He remarks (l.c. p. 270): "Here and there were dead mummified remains of boobies. Among these I observed no very young birds, and only five adults, while all the rest were nearly grown young. The partly ossified skull was unmistakable even where the plumage had fallen off and blown away, and I believe that the crisis of the entire life is the achieving of the crater's rim, after the wings have acquired sufficient strength and before the almost mechanical cessation of feeding instinct on the part of the parents. There is undoubtedly a trenchant survival of the fittest, at this brief temporal period, in value to the race far transcending the elimination of young birds by enemy gulls in mainland colonies".

Certainly not all young birds are treated in this nonchalant way for on Gg. Api many full-fledged birds were fed regularly by the adults, even young birds which I saw looking for food themselves near the volcano. Correia, too points to the fact that flying young are fed (Murphy, Bull. Amer. Mus. N.H. I, 1924, p. 255).

The fact that in many cases the feeding takes place at widely diverging places, where no nests or traces of them were to be found, makes it probable that the victims described above were abandoned. From the above remarks we conclude, that the victims were inferior specimens, which at the age that most birds are able to seek their food could not find the food-sources. (For details see our notes on p. 456 concerning the behaviour of *Puffinus puffinus*).

H.

Sula dactylatra bedouti MATH.

Sula dactylatra bedouti **MATHEWS Austral. Avium Record 1, 1913, p. 189, (Isle Bedout. S.W. Austral.).**

Cat. Nos. Btzg. Mus.	Sex	Culmen	Bill from gape	Wing	Tail
9213	♂ juv.	91	110	370	174
9214	♀ juv.	96	118,5	405	180
9215	♂ ad.	96,5	118	415	196
9216	♂ juv./ad.	96,5	117	(400)	184
9217	♀ ad.	103	127	417	196
9289	(♀) pullus	94	116	(347)	168

Number 9289 is a pullus, partly in white down covering.

In nape dark brown feathers with white tips. Wing coverts with much white down. Quills and tail dark brown, tail feathers with greyish white base; back and rump have dark greyish brown feathers with a vaguely outlined white margin. Belly entirely white. Iris dark grey, bill dull olive green, with deep grey base; orbital skin light olive green; bare throat light bluish grey; legs dark grey. Number 9213 and the bird just described are about alike; but it is older and shows traces of white down only on crown, throat and wings. Head and nape dark brown, with irregular white markings, wing coverts brownish grey with light margin on the separate feathers. Iris light bluish grey. For the rest like Number 9289.

Number 9214 is a somewhat older bird, which has already lost all its down. Neck and thoat dark brown with irregular white markings. Skin of head and throat slate-blue. For the rest like Number 9213.

The other birds are adults, but number 9216 still has a remnant of the juvenile plumage in the form of irregular brown spots on the white rump; yellowish green eyes; yellowish green bill and grey skin of the head. In the fully developed adults the eye is yellow. As stated by HOOGERWERF, in living birds the ♂ has dark-yellow, the ♀ light-yellow or greenish-yellow eyes; bill bright yellow in male; in female yellowish green; skin of head in male dull black; of female slate-blue; feet olive green to bluish grey.

This form might be reckoned, with some reserve, among the subspecies *bedouti* MATH. It is, however, still an open question if *bedouti* can be separated from the subspecies *personata*. I had no material at my disposal of this last subspecies.

See for this CHASEN, Bull. Raffl. Mus. VIII, 1933, p. 69, and ibidem XI, 1935, p. 65, note). **v. B.**

The Eggs.

The complete set consists of 2 eggs. Nests in which one egg was found,

contained two 5 to 7 days later. The shell has a fine bright blue-green colour almost entirely hidden by a dirty, rough lime-layer. Only in some eggs the colour of the shell shines through, which is also the case when the lime-layer has been scratched away by the nails or beak of the bird.

The lime-layer varies in colour from white to dark rusty-red, only in rare cases do the eggs lack the dark spots. Although the dark spots are undoubtedly and chiefly caused by dirt, they occur also on fresh eggs.

Twenty eggs, measured by me, varied from 56.5 - 72.5 mm in length, and from 40.5 - 45.5 mm in width. The longest and widest eggs measured 72.5: 42.5, and 60: 45.5 mm, respectively. Maximum variation in one set 6 mm in length, 2.5 mm in width. **H.**

Biology.

The number of this bird at Gg. Api is small and does not exceed at a rough estimation a total of 100 to 150 birds. This number could only be observed in the afternoon when all animals had flown home with food, or visited the warmth of the solfatara's. In the morning ordinarily the number to be seen was limited to the breeding specimens, often accompanied by the partner.

We usually found the birds in pairs, not only when having a nest, but also when apparently possessing neither eggs nor young. Whether in such cases the birds always formed pairs could not be established.

As said before this species seems also to feed far from the breeding places.

Apart from the differences in colour of the beak and of the iris, the voice, though rarely heard, seems to be different in both sexes. In the female it reminds one of the call of the large sea-eagle *Haliaeetus leucogaster* and sounds almost as "hark-hark-hark", while the male produces a whistling sound. This observation agrees with those made by Beebe on *Sula nebouxii,* and by Snodgrass & Heller on *Sula dactylatra* of the Galapagos Islands. However, sex difference was not correlated with voice by the latter authors.

Beebe (Galapagos 1924, p. 271) remarks: "A blare of brazen, raucous trumpet-like notes mingled with squeaks and shrill whistlings. I killed a trumpeter and a whistler and found that they were female and male respectively, and I also recorded that the eyes of the two were wholly unlike. In equal shadow the pupil of the male was small, the iris almost clear yellow; in the female the pupil was about once and a half as large again and the yellow iris was more or less mottled with brown".

Snodgrass & Heller (vide Bent U.S. Nat. Mus. Bull. 121, 1922 p. 196) write: "The most common note uttered by the adults was a loud quack. Occasionally a sharp whistle was heard, but no special significance to this sound was observed".

At Gg. Api eggs and young were found without exception on the barren soil. So far as we could establish the birds did not use any nesting-material.

It seems uncertain whether the numerous small stones found round the breeding birds may be considered as nest-material. We did not see the birds bring the stones to the nest. However, while sitting on the eggs, the bird may take a small pebble in its beak and rock it close to the egg, like we also observed in Holland with *Charadrius a. alexandrinus* L. and *Sterna a. albifrons* Pallas which gather a small ring of shells or shell-parts around themselves while breeding.

Both sexes seem to incubate the eggs equally, the other bird often acting as a companion, as stated also by BENT (l.c. p. 195). The sitting bird may be approached to within a distance of some feet without causing it to rise. At our approach the breeding birds moved uneasily about, while nodding nervously.

It attacks, as a rule making exclusively use of its beak. In order to examine the nests the birds often had to be removed with a stick. Even then the brave birds often did not leave the nest or only walked some meters away from it and returned as soon as possible.

Before sitting down again on the nest we observed a few times birds clasp the eggs between the webbed feet, thus showing their determination to hold fast to their brood. According to BENT (l.c. p. 194), ANTHONY mentioned a similar behaviour in *Sula dactylatra* on the Revillagigedo Islands near Mexico. This author describes the attachment to the nest as follows:

"The nests were all vigorously defended by the birds, who greeted our approach with deafening shrieks and threatening bills", and: "I several times found the present species sitting on large sea-shells which in shape and size somewhat resembled their eggs. The "boobies" seemed perfectly contented with the substitute, and I often supplied them with the shells after taking their eggs".

Notwithstanding the fact that nearly always two eggs were found in one nest, two young of seemingly one nest were never observed together. If two or more young were assembled, they soon separated at the return of the adult birds with food. As I saw the parents only feeding one young at the time the fate of the second bird had to be investigated. Observations with marked nests and on the embryos of the two eggs of one nest, point to the fact that the second egg is laid 5 - 7 days afterwards. This seems to explain the fact that the nest finally contains only one young.

Other authors comment upon this considerable lag of time in the laying of the two eggs and its possible relation with the surviving of only one of the young in other kinds of boobies. While MURPHY points to the possibility of only one egg being hatched (Bull. Am. Mus. N.H. I, 1924 p. 252 - 253), SHIRAS (Hunting wild life etc. p. 225) assumes that the younger bird is devoured by the first hatched. In a description of a trip to the Bahama-Islands near Florida he remarks: "The mystery of the missing young of the boobies was solved when we discovered the peculiar fact that there appeared to be a difference of ten days between the eggs, so that the first hatched became the sole survivor".

MURPHY's suggestion, however, offers hardly an explanation of the phenomenon. Considering the fact, that the young bird is covered continuously during the first weeks, it is obvious that the development of the embryo will proceed normally. In this connection the remark of T. M. CHAPMAN (SHIRAS l.c. p. 224) regarding *Sula leucogaster* seems important, that: "Brooding continues even when the white down is well developed; the young bird is then too large to be wholly covered by the parent, and lies flat on the ground, the head exposed, the eyes closed, apparently dead".

Though I cannot offer any proof, because I did never find two young birds in one nest, I am inclined to believe that the second egg, too, is hatched and that SHIRAS is right in assuming that the newly hatched bird, like in some other bird species, is devoured by the older nestling. A seven days old booby may be considered as wholly capable to swallow a newly hatched young. Moreover the difference in strength of both young birds will increase daily as the adults cannot prevent the bigger one getting the more food, a fact repeatedly observed by me with some species of herons and other birds. — The possibility of the second egg being devoured or removed by the older chick or the adults does not seem likely to me according to my experiences with other birds.

In this connection the statement by FISHER (BENT, l.c. pag. 195) cited below, seems interesting: "It is a curious fact that although there are two eggs, only one young is reared. Often all signs of the second egg were removed, as if the young had hatched and had been devoured by a parent or some marauding *Fregata.* But more frequently there would be one nestling and one egg. Sometimes this egg was spoiled, sometimes contained an embryo. In one case I found two newly hatched young, one of which had already been trampled to death. Prof. NUTTING saw one large nestling and one small still alive, but I doubt if it lived long. The presence of only one young bird has been noted in the eastern Pacific at Clipperton Island by H. R. BECK, and ROTHSCHILD mentions the same fact for Laysan. The voracity of the bird first hatched is probably responsible for the death of the second".

The possibility of the food-robbing *Fregata* devouring young boobies, may be excluded for Gg. Api birds. During my stay at the island I not once observed that frigate birds preyed upon young birds of whatever species. The sharp watch kept by the adult *Sula* over its chick is one more argument for this contention.

As I never observed newly hatched chicks, and of those of about ten days only few specimens, I cannot present any data upon the some days old young. I presume, that like *Sula sula* and other boobies, *Sula dactylatra* emerges naked from the egg and that the white down grows within 2 or 3 days. Also the ten days old chicks present this down and no considerable change can be detected for before another two weeks. Not earlier than after the age of about three or four weeks it presents considerable change in general appearance, as described above and shown by the photographs.

During my three weeks stay at Gg. Api I have not been able to ascertain at what age the young become fully fledged. However, considering certain observations on the growth of *Sula dactylatra,* I am inclined to assume that this will be at the age of 10 or 12 weeks.

In many cases flying young birds are still fed by the parents. In feeding, the young booby thrusts its head into the wide opened beak of the parent and gets its food from throat and crop. After this the old birds retire to a spot out of reach of the young, probably to escape the begging of the young.

At the appearance of the adult bird, the young runs or flits to meet its parent, stoops down flapping its wings, swaying head and neck, in the meantime uttering a squeak, touching intermittently the beak of the older bird and snatching the food from beak and throat of the adult bird. The feeding of the not fully fledged young generally occurs at the nesting place which is coloured chalky-white by the excrements of the birds. When the young had moved away from the nest, it did not take the adult birds a long time to find them, after their return to the empty nesting places. The feeding of bigger young often takes place at considerable distance from the nest.

Concerning the feeding of very young birds, I do not have any particulars. Dr. Fisher (vide Bent l.c. p. 195) remarks: "The young one inserts its head fairly into the throat of the parent, in a decidedly gruesome matter, and catches the disgorged food. In fact the young one's head went so far into the parent's throat that I became solicitous for its safety".

The young which I saw fishing near the island, caught their prey while floating with submerged head and neck. In some stomachs I found parts of fishes e.g. those of flying fish and squids. Of the squids we found only the dark parts of the beak.

Young birds, showing a transitional feathering between that of full-fledged young and the adult birds were rare on Gg. Api; I only observed 2 of them. Considering the large number of young birds which were not yet or hardly able to fly I was rather surprised to find so few birds in transitional feathering. The presence of so many young birds and eggs makes it extremely unlikely that human intervention may have caused this lack. I am unable to present an explanation for this curious fact.

Big young birds, fully able to fly, are obviously unwilling to do so. They always tried to outrun us, and were sometimes easily caught by hand. The older birds perched at level spots, seemed also disinclined to take wing. Rising from the flat ground is obviously rather difficult; as a rule they try to find a higher starting point, from where they swerve down. If they fail to do so, they run flutteringly and finally take wing for escape. Several times I observed that the seed of the kneedeep grass *Cenchrus inflexus* stuck to the feathers of the fluttering *Sula dactylatra*. **H.**

Phaeton rubricauda westralis Math.

Phaeton rubricauda westralis Mathews, Austr. Avium Record I, 1912, p. 88, (West Australia).

Cat. Nos. Btzg. Mus.	Sex		Culmen	Bill from gape	Wing	Tail from base of central feathers.
9100	(♀)	pullus	23	36,5	—	—
9101	♀	pullus	31,5	47	—	—
9102	♂	pullus	44,5	61	—	—
9103	♀	juv.	48,5	70	190	—
9104	♀	juv.	54,5	75	242	—
9105	♂	ad.	55	82	334	390
9106	♂	ad.	59	84,5	320	398
9107	♀	ad.	61	88	310	307

The numbers 9100 and 9101 are nestlings in white down covering. In living nestlings Hoogerwerf stated the down to be pearl-grey. Perhaps the colour fades in dry skins. Number 9101 has traces of grey down on tail and wings. Number 9100 still has an egg-tooth.

Iris dark brown, bill dark grey to black; shank flesh-coloured; sole dark grey, orbital skin greyish blue.

Number 9102 is an older nestling, already with black and white streaked feathers on wings and back of the juvenile plumage. In the tail two black central feathers are just beginning to develop. Colours of bare parts as in the others. Number 9103 has entirely white underparts, with a slight pinky reflection at belly, breast feathers with black central spots. Upperside black and white streaked. Neck, shoulders, rump and throat have dark grey down. Before the eye a black spot, not continued behind the eye, as in the adult animals. Forehead and cheeks white. The two central tail feathers jut out from the tail for about ¾ inch and are white with black tips and black quill. Colours of bare parts just like those of the birds last mentioned, but base of lower mandible light grey. The bird had not yet left the nest.

Number 9104 already entirely feathered. The plumage resembles that of Number 9103, but has no remnant of down-covering. The markings on the breast have been reduced to some black bars. The quills of both central feathers have broken off, so that nothing can be said about their length. Iris darkbrown, upper mandible black with bluish grey base, lower mandible black with flesh-coloured base. Shank light bluish grey; sole for the greater part dark grey. The three other specimens are adults and were found breeding. Central rectrices in number 9105 are about equally long. The longest of the two is the newest. In the two other birds only one tail feather has been developed, the other

tail feather has scarcely begun to grow. In one case the left feather is the youngest, in the other case it is the right feather.

In this series there is nothing disproving the theory of a completely regular alternative moult as contrasted with an irregular moult, as shown by Chasen for part of his material of *Phaeton lepturus fulvus* of Christmas Island (Bull. Raffl. Mus. 8, 1933, p. 79). Chasen himself did not find this irregular moult in *Ph. rubricauda*. This does not imply of course that such irregularities do not occur in *Ph. rubricauda*, for such an inference the series of Christmas Island and the one in question are both too small. The length of the wings of the adults corresponds to that of Christmas Island. Only the adult ♀ has a strikingly short wing. Chasen (l.c. p. 77) points to the fact that winglength is not a suitable feature to distinguish *Ph. rubricauda westralis* from the typical form. The bills of the Gg. Api birds, however, are very short and therefore belong to the subspecies *westralis*, whose short bill is the most typical mark of identification.

v. B.

The Eggs.

The egg belongs to the most striking of all the types found on Gg. Api. The fairly coarse shell is bright white. In most cases this colour could hardly be observed as it is entirely covered by specks and dots which diverge a great deal in colour. Bright to dark lavender to purple seems to be the most common colour, but we also found eggs with a bright to dark gray and a brownish gray marking. The type of the marking too is not very regular. Ordinarily the dots are small, closely spaced and regularly distributed over the surface of the shell, but in other eggs the shell is coarsely dotted and the dots are concentrated at the blunt pole of the egg or at both poles. One egg was found that was almost purely white. At the blunt pole a few dirty purple spots appeared. These large spots seemed to be superficial as they could be removed by moistening the shell and scratching it, which was not the case with the small spots. A few specimens give the impression as if the colour was applied by a coarse brush in longitudinal direction. Generally the eggs show similarity with those of some birds of prey.

In 22 eggs the length varied from 47 - 68.5 mm and the width from 42 - 47 mm. The largest egg measured 68.5: 47 mm. **H.**

Biology.

The tropic bird is also a common appearance in the bird life of Gg. Api. Occasionally one may observe one or two specimens at a time returning from sea during daytime; they are most numerous in the morning hours or in the late afternoon.

Their hidden life-habits however, makes an estimation of their number extremely difficult. During its stay at the island the bird hides in cavities of the rocks where it lives lost to view.

Never we observed *Phaeton* fishing near Gg. Api. From an examination of the stomach-contents of some of the collected birds and observations on the

feeding of the young it appeared that the diet of this species too consists nearly exclusively of flying fish and squids.

CORREIA (vide MURPHY: Bull. Am. Mus. N.H. I. 1924 p. 257), comments on the foraging of *Phaeton aetherus* as follows: "The juncos dive deep for the fish upon which they feed, and they remain several seconds under water, finally emerging with a fish crosswise in the beak or half swallowed".

Writing about *Phaeton lepturus catesbyi* the same author remarks (Nat. Geograph. Mag. 74, 1938, p. 250): "They feed by hurtling like arrows into the ocean a fact commemorated by their generic name, which they take from the illfated son of Apollo who fell from his badly managed chariot into the deep. Squids appear to make up the bulk of the tropic birds' diet".

Returning from the fishing grounds, generally solitary or in couples, the Gg. Api-birds mostly disappeared from view as soon as they reached the island.

These homing birds hurtle down right into the caves or in the immediate neighbourhood. In the latter case they shuffle along to the nest using the small legs or their wings. Rarely a bird is found lingering beyond the shelter. As a fact *Phaeton* seems rather in a hurry to hide in the cave at once; their inability to walk on the small legs or to take wing from a level surface may explain their cautiousness. The white feathering, moreover, is rather conspicuous to enemies hovering about.

One often can hear the thud of the alighting birds, even when the birds arrive at some distance. The very short and rather weak legs seem absolutely insufficient to break the fall of the rather heavy body.

To this point CORREIA, (vide MURPHY Bull. Am. Mus. N.H. I, 1924, p. 257) states about *Ph. aetherus:* "The feet are small and weak even in adults, and the "juncos" neither walk nor stand up. On the contrary they rest with their breasts on the ground, and when they progress over the short distances between the nest-chamber and the jumping-off place, they push along on their bellies".

NEWTON (vide BENT, U.S. Nat. Mus. Bull. 121, 1922 p. 191), mentions the fact that *Ph. rubricauda* ascends with great difficulty from a flat surface: "......; in fact, like all birds which have their legs placed so far behind, they can not rise off a flat surface but require a drop of a few feet to give them an impetus".

Frequently we observed these birds flying along the slopes and poising before different shelters, a behaviour resembling the hovering of birds of prey. Not rarely several birds at the same time behaved in that way.

In this community-flying some more acts have been observed which seem to bear connection with the mating. Every day a number of tropic birds, varying from 5 till 10 were observed circling along the steep western slopes and above the craterpit, emitting a cry that sounded like: "uk-uk-uk-wow...uk-uk-wow" or "ûwûk-ûwûk-wow", intermittent with the cry "keeup—keeup—keeup" or "keeup—keeee". Flying round, the tail, pointed down obliquely, was wagged

vigourously. Next moment the bird assumed, heavily beating its wings, a vertical position apparently without moving from its place.

Correia (vide Murphy, Bull. Am. Mus. N.H. I. 1924 p. 257) made similar, however slightly diverging, observations on *Phaeton aetherus* and describes their flight as follows: "They fly straight to their respective clefts or cavities in the cliff but, instead of alighting, they poise a while in air with the feet and tail trailing, and then wheel and describe short circles very rapidly, after which they return to the nest-site and poise once more".

Alexander states (cf. Murphy, ibid. p. 255): "Towards sundown these birds congregated over some favorite spot and indulged in nuptial flights, at times circling high in the air and uttering the whole while a series of harsh screeching notes that bore a striking resemblance to those of the common tern during the breeding season".

As said before, eggs and young of *Phaeton rubricauda,* never more than one in a "nest", were found without exception at places as described above. Not in a single case I observed that nesting material had been collected by the bird itself. The nest-cavities were often so deep that we only heard the breeding birds shriek when we were near the nest, walking f.i. overhead.

Besides holes and cavities in the mountain-slopes and among the lava blocks, the birds at Gg. Api show also a preference to inclining stones and low growing shrubs, where they can sit the whole day or the greater part of it protected for the heat.

Beebe also states the breeding between lava-blocks of *Phaeton* at the Isle of Daphne.

In the rare cases where the nests were exposed to sunshine, we supposed, that the birds were "mistaken" in their choice of the nesting place and the egg was laid on a dark day when the bird could not take into account the bad consequences connected with their habitation. Here they were suffering from heat to such an extent that they sat in the nest gasping for breath their body shaking vehemently with convulsions to a degree as I never before saw in other birds.

The way of nesting at Gg. Api is different from that of the allied *Ph. rubricauda rotschildi* as related by Murphy (N.G.M. 74, 1938, p. 250): "The species differs from other tropic birds in that it nests on the ground of low islands instead of seeking lofty niches in cliffs. In keeping with this habit it has considerable agility in rising into flight from a level surface, which it does by scurrying along foot after foot, rapidly beating its wings".

Phaeton does not react if one passes at a distance from the nest. If this be the case, e.g. if one treads too close to the nest, upon which the incubating bird is perched, it produces a piercing "uk - uk - uk" or "klieuw — àkieuw...... klieuw — àkieuw", thus betraying the location of the egg.

At the approach of men the tropic bird does not leave the nest but attacks as soon as danger is imminent; even when I tried to snatch the egg away, the

parent did not budge and remained at its post. I am under the impression that in such cases *Phaeton* holds on to the clutch, for I saw the bird stand on the defensive, waddling in the nesting cavity with the brood firmly gripped. The egg may only be obtained by expelling the bird by force or by keeping the beak tightly shut. After removing the clutch, I observed several times that the birds remained at their nests, sometimes for one more day.

The territory, in which no intruder is allowed to enter, the hole or entrance to the nesting-cavity, is violently defended, even against birds of the same species. If another *Phaeton,* in search of a hide-out, attempts to enter another bird's nest-hole, it is involved at once in a fight in which bills as well as wings are acting fiercely. The birds shuffle along the ground with vertically outstretched wings like swans on the water, shrieking loudly, "ukukuk—kleeuw", "kleeuw - akeeuw", or "keee". The trespassing bird as a rule retraces its flight almost immediately in search of another hiding place. Even a young and an adult *Phaeton* were observed fighting in this way.

CORREIA comments upon this behaviour in the following way (vide MURPHY Bull. Am. Mus. N.H. I. 1924 p. 257): "They seem to be suspicious one of another. A bird which has alighted makes loud outcries and attempts to peck any other bird which shows that it would like to descend near the same place. Should the approaching bird actually perch, the other flees from his post". The latter was never observed by us.

At first I believed that a similar "kind" reception was bestowed upon the mate of the breeding bird too. Later I was able to review this opinion as I actually observed a most peaceful conduct of the partners, changing guard.

I also differ from CORREIA, where he writes (MURPHY Ibid. pag. 257): "The male "juncos" also appear to be very jealous of their mates. If a strange male approaches a niche in which a female is brooding, the mate of the sitting bird promptly takes the invader to account, with ear-splitting calls".

Such a conduct has never been observed by me, in almost every case I only found one breeding bird in the nest-hole.

The egg is incubated by both sexes equally. I was not able to tell which is the male or the female.

In changing guard the birds perched in the entrance, or the nest-hole, bills almo st touching and shrieking as if an attack was forthcoming.

The young are cherished about a fortnight after hatching and just like the egg defended fiercely against intruders. However, on several occasions I observed how the small young were left alone for rather a long time.

The bigger ones lie in the nest unprotected and quite helpless for the greater part of the day and perhaps whole days. No trace of the older birds is then to be observed.

Feeding the young resembles somewhat the method in use by the herons, e.g. the aigrettes. I could not find out, however, if, like in the case of aigrettes, *Phaeton,* when feeding very young birds, spills the food on the nest, before the hungry off-spring.

Once, I actually saw a chick of only a few days old, snap at the bill of the parent and taking the food from it. In order to facilitate this, the adult bird inclined the head a little so as to enable the young to catch the food.

The chicks will take hold of the beak of the adult in such a way that the tip of the beak disappears into the bill of the young. In the case of halfgrown birds, the beak of the parent enters almost entirely into the throat of the young, where the food is disgorged. The begging sounds like "aie-weee-weee-weee...... aie-weee-weee-weee".

Once I saw a circa 14 days old young spilling a fish about 20 cm long. However, I could not observe the fish being swallowed by the chick, as the beak of the adult bird was plugged down so deeply into the throat of the young, that the bases of the bills were touching. Though I watched the feeding very closely, I could not see from the outside how the young bird managed to swallow this large prey.

With regard to this species I also ascertained as with *Sula leucogaster* the strange fact that a fairly large number of half-grown birds had died. In contrary to the chicks of *Sula leucogaster* these dead ones were all found in the nesting-cavities and never outside. A great number of them were so big that it may be assumed that death overtook them when they were almost full fledged.

As remarked already above when speaking about *Fregata minor*, *Phaeton* much suffers from the food-robberies by the frigate-birds, through which it certainly often happens that the adult birds return to their off-spring with empty crop, but I think it improbable that in this fact may be seen the solution of the problem.

BEEBE (Galapagos, pag. 263), who reported the same for the tropic birds of the Island of Daphne, fails to give an explanation for this curious fact. He says about this matter: "Sheltered on all sides, armed with sharp, saw toothed beak, the Daphne tropic bird have absolutely nothing to fear, and yet within a few feet of the crevice lay two mummified young birds and one adult, while in a narrow niche at one side of the nesting ledge was a cold egg. The egg was easily explained, the shuffling, awkward gait of the old birds must have given it a flick which rolled it into the narrow corner. But the dead birds were a puzzle, and the only explanation was family jars-tragedies of jealousy".

Rather interesting in connection with the facts stated above seem the observations of Mr. R. M. LOCKLEY (Nat. Geogr. Mag. 1938, p. 252) on *Puffinus puffinus*, found by him at the island of Skokholm, some miles out of the Pembrokeshire coast of Wales. The author says, that though the young of these birds in the beginning are fostered day and night by the adults, soon the care slackens and that when the definite feathering appears they are fed only once a night and on moonlight nights were neglected completely (this petrel is said to prey only at dark nights and to keep quiet during the day).

After nine weeks, when nevertheless, the young still were in a fairly good condition, they were deserted altogether. The author traced this fact in a very clever way. In one case observed by him the young after the desertion of the

parents, remained cowered in the nest-hole for 6 consecutive nights. In the seventh night it moved away and, during the following days, sat flapping its wings before the hole but not yet able to take wing. A marked decline in bodily condition was apparent.

The author does not tell if this young bird ever reached the shore but at the end of his tale he relates that the young "blunder downwards to the cliff and flutter to the sea", where they succeed in finding their food and escaping their enemies by diving under water. No mention is made in the said paper about the occurrence of dead young, but it seems probable that birds will fall victim to this Spartan education.

Perhaps *Phaeton rubricauda* behaves in a similar manner and the found mummies might be of young birds which failed to find their way to the feeding grounds.

Moreover, it is remarkable that I never saw a flying young tropic bird at Gg. Api in the juvenile feathering. Considering the great number of sturdy chickens in the holes it is not likely that not a single one fled the nest.

It may be that soon after leaving the island they travel a long way from the volcano and do not return there for a time.

Similar conditions have been reported by Newton (Bent l.c. pag. 192) from the breeding grounds of the red tailed tropic bird at Mauritius. Newton remarked on that score: "There were to be found about as many young as eggs, some of the former almost as large as their mothers, and nearly able to fly, but I did not see a single immature bird that had started in life on its own account, though I have no doubt many had already done so". **H.**

Anous stolidus pileatus (Scopoli).

Sterna pileata Scopoli, Del. Flor. et Faun. Insubr. fasc. 2. 1786, p. 92, (no locality = the Philippines ex Sonnerat).

Material:

Cat. Nos. Btzg. Mus.	Sex	Culmen	Bill from gape	Wing	Tail	Colour Pullus
9245	(♀) pullus	13	20,5	—	—	brown
9246	(♂) pullus	14,5	23,5	—	—	white
9247	? pullus	13,5	21,5	—	—	white
9248	♂ pullus	16	26,5	—	—	white
9249	? pullus	16	26,5	—	—	brown
9250	(♀) pullus	18,5	30	—	—	brown
9251	(♀) pullus	16,5	28	—	—	white
9252	♀ pullus	18	29	—	—	white
9253	(♀) pullus	19,5	30	—	—	brown
9254	(♂) pullus	17,5	29	—	—	white
9255	♀ pullus	20	30,5	—	—	brown
9256	♂ pullus	21	33	—	—	white

Cat. Nos. Btzg. Mus.	Sex		Culmen	Bill from gape	Wing	Tail	Colour Pullus
9257	(♀)	pullus	21	33	—	—	brown
9258	(♀)	pullus	22,5	34,5	—	—	brown
9259	♀	pullus	23,5	37	—	—	white
9260	♂	pullus	28	42	—	—	?
9261	♀	pullus	26	41	—	—	?
9262	♀	pullus	26	41	—	—	?
9263	♂	juv.	32	50	230	139	—
9264	♂	juv.	33	53	239	146	—
9265	♂	ad.	40,5	56	274	176	—
9266	♀	ad.	38	56	276	174	—
9267	♀	ad.	42	58,5	279	173	—
9268	♀	ad.	39	54	264	167	—

Of this species Mr. HOOGERWERF collected a marvellous series of young birds of all ages from the very young nestlings in down to the adults. Especially the young ones are very interesting, showing a distinct dimorphism. In SAUNDERS (Cat. Birds. Brith. Mus. Vol. 25, 1896, p. 140) I found that the young ones of this species are not uniform. He gives the following description: "......has the forehead and crown dull white, lores blackish, upper surface mousebrown, nape and throat darkest, lower parts paler. Another, only just hatched, is nearly uniform sooty brown".

One form of the young Gg. Api birds is like the first description of SAUNDERS. Not one of them is "uniform sooty brown", whereas most other descriptions of young birds mention this very colour sometimes adding "paling to sooty white on the abdomen" (STUART BAKER, Fauna Brit. Ind., Birds, Vol. VI sec. ed. p. 146) or "soon acquiring a white line above the lores". (ROBINSON & CHASEN, Birds Malay Pen. Vol. III p. 107). Besides this form there is another type of young in Gg. Api. T h i s t y p e i s p r a c t i c a l l y p u r e l y w h i t e, only down on shoulders, back and tibia with greyish brown tops, which causes the upperside to have a spotted aspect.

This white phase is also mentioned by BENT (Bull. U.S. Nat. Mus. 113, p. 307) but unfortunately he gives no further informations. As far as I know this white phase was not yet reported for Indo-Australian Noddies. How far dimorphism is typical of certain breeding-colonies is naturally an open question, but it is scarcely to be supposed that such a strikingly light type should have been overlooked in the breeding-colonies that have been examined in this part of the world. Any connection with age or sex does not exist, as may at once be be seen from the table and pl. 33 fig. 1.

All nestlings in down covering have iris dark brown, bill black to greyish black; legs dark grey to dark brownish grey; the juvenile covering is rather uniform brown with blackish brown quill- and tailfeathers. Very remarkable is the change of colour of the head. All young birds have a white forehead

and in the first feather covering it remains white to greyish white. An exception to this rule is number 9258, a young one, partly in feathers and a feathered head with brown forehead with slight white spots and marked with a white line above the lores. Only Number 9264, one of the two fullgrown but still immature specimens in our collection, also has such a marking of the head, the other, number 9263, has a white forehead with a darkbrown spot at the base of the upper mandible. All other nestlings, partly in down and partly in feather covering, have a white forehead speckled more or less distinctly with brown. In number 9261 the upper part of the head is even entirely white with a little brown on the crown. Number 9260, nearly as old as number 9261, has a little brown spot on the base of the upper mandible.

Even in half feathered nestlings in down, the lores are distinctly black. Delacour & Jabouille (Trav. Serv. Oceanogr. Indochine 3e Mem., 1930, p. 15) also emphasize this development of a white forehead in young birds to brown with white eye line in immatures and then pearlcoloured greyish in adults, while I did not find it stated anywhere else. The colours of the bare parts are alike in all the birds, both in juveniles and in adults, viz., iris brown; bill black; legs dark brownish grey. The measurements of the wings of Gg. Api birds are somewhat shorter than those of adults from the Paracel Islands given by Delacour and Jabouille (l.c.) and from several localities in the collection of the Raffles Museum, given by Chasen (Bull. Raffl. Museum 8, 1933, p. 63). Average length of tail, however, larger.

An adult ♂ of Kebatoe cliff (S. of Billiton) in the collection of the Buitenzorg Museum has a wing of 282 mm, tail 156 mm, an adult ♀ of the Tabbotaha Reef in the Soeloe Sea has a winglength of 269 mm, tail 156 mm. **v. B.**

The Eggs.

Without exception I found in the nest of this bird only one egg at the time. The dull or almost dull shell is white to cream-coloured and covered with a number of irregular primary and secondary spots and dots, often concentrated at the blunt poles, seldom at other places. In some cases small lines may be seen between those dots. The secondary dots are bright to dark ash-coloured while the primary irregular dots vary from bright to dark marroon. In a few cases, even from a dark amber to black. The dirty spots on some of the eggs possibly appeared after the eggs have been laid. They vary considerably in size as well as in pattern. In 24 eggs the length varied from 46 - 53.5 mm, and the width from 32.5 - 37.5 mm. The largest egg measured 53.5 - 37.5 mm. **H.**

Biology.

The Noddy may be considered the most common bird of the island. It seems not particular about habitat for I observed the bird living all over the volcano. It nests among the lava blocks at the shore where the spray of the ocean dashes against the nesting birds, as well as in the higher zones just

about the fuming solfatara devoid of all vegetation because of the high temperature and the composition of the soil. Once I found some nests in a dark cave which I visited in search of bats and swifts, where no other living creature could be traced than this very *Anous*.

As a rule the gregarious birds were nesting together in small groups. At first sight *Anous* resembles more a gull than a tern. We drew at once a comparison with the black headed gull *Larus ridibundus* of the temperate zone, with which *Anous* displays a striking resemblance in appearance and behaviour. Perched among the boulders or solfatara-slopes or flying in small flocks over the sea, the birds presented more likeness to this gull and even to certain kinds of pigeons than to terns.

CHAPMAN (BENT, U.S. Nat. Mus. Bull. 113 p. 308) made a similar comparison. He writes: "As the only tern with a rounded, instead of forked tail, the noddy might be expected to differ in flight from other members of its family. In fact it suggested, when in the air, a light bodied, long-winged, long-tailed pigeon".

We figure that on Gg. Api a constant total of several hundreds of these birds can be seen day by day and as we never saw them stray far away, we venture to say that the feeding grounds, contrary to that of the larger oceanic birds, were lying near the volcano. In fact I watched them fishing in that neighbourhood. According to BENT (l.c., p. 308), WATSON mentions that as a rule *Anous* forages at a distance of 9 or 10 knots from the breeding grounds and rarely turns away a distance of 15 miles or more out of the coast.

DELACOUR & JABOUILLE (Trav. Serv. Océanogr. Indo-Chine 1930, 3e Mém. p. 15) mention that the birds live at high sea and feed upon molluscs and floating dead fish.

About the feeding-habits WATSON observed (vide BENT, l.c. p. 307): "In a locality where marine-forms are so abundant as in this favored Gulf region, the terns collect their food with little difficulty. They feed upon small fish of different kinds, which are present in great abundance. Examination of the stomach contents of both young noddies and sooties showed the presence of representatives of the two families of fish *Carangidae* and *Clupeidae*.

To my great surprise I found that the birds never swim nor dive. As a matter of fact, they never touch the water except when drinking or bathing. The bird drinks the seawater as it skims the surface of the water with open beak. Bathing they perform in much the same way, never coming to a stop in the water nor completely immersing the body; usually the breast and head are the only parts dipped into the water.

The birds fish by following schools of minnows which are being attacked by larger fish. The minnow in its efforts to escape, jumps out of the water and skims the surface for a short distance. The terns pick of these minnows as they hop up above and over the surface of the water. The rapidity and accuracy of visual-motor adjustment in this reaction is wonderful".

Contrary to this observation, AUDUBON (vide BENT, l.c. p. 308) remarks

that *Anous* "swims with considerable buoyancy and grace, and at times immerses its head to seize on a fish".

During my twenty-days stay at Gg. Api I did not even a single time see a swimming or bathing *Anous.*

In the stomachs of young as well as of adult birds examined by us at Gg. Api, we found rests of fish, mostly flying fish and squids, sometimes pebbles and a few down-feathers which may be swallowed by the birds when pluming.

Marauding of other species of terns as mentioned by Delacour & Jabouille (l.c. p. 17), was never observed by us.

On this behalf these authors remark: "......c'est ainsi que les sterns sont poursuivies par les Niais (*Anous*) qui les forcent a dégorger les poissons qu'ils viennent d'avaler, que les Niais eux-mêmes sont victimes des Fous, lesquels sont a leur tour persécutés par les *Frégates*".

The "salutation-ceremony" on the nest or elsewhere, consists of a series of bows with wide-opened beak. I got the impression that the tongue was turned up high in the lower bill. When stooping downwards *Anous* persisted in this attitude with beak pointed to the webbed feet as if surprised by a sudden discovery which held its interest in such a degree as if the bird had forgotten all about the salutation. During this ceremony a low, unconsiderable and hoarse sound was produced.

Besides this "bowing-ceremony" another sequel of actions was performed which may be characterized as "crowing ceremony". Here the head and throat were raised obliquely and a soft "kra-kra-kra" or "kurr-kurr-kurr" was heard.

The nest-places vary widely. Along the sea-shore where vegetation is scarce upon and between the lavablocks of the slopes, a large number of eggs is laid upon the bare rocks. Higher up the mountain, along the old lava-bed, numerous birds lay their eggs into the rich vegetation of grass, herbs and shrubs of the species *Cenchrus inflexus, Ipomoea pes caprae, Trema virgata* and *Caesalpina crista.*

Also in the *Pisonia* wood some breeding birds were found, sometimes at a considerable elevation above the ground, moreover in *Ficus*-trees and on the leave-bases of coconut palms and *Pandanus!* As has been mentioned above numerous clutches were found on the barren hot solfatara-fields and even in a dark cave along the West-side of the volcano.

The same inconstancy existed in nestbuilding. Often I found the eggs deposited upon the rocks or the barren soil, devoid of nesting material. In contrast with this, a great many nests composed of dry leaves among which those of *Pandanus* and seaweed, reminded us of the ponderous nests of the black headed gulls, to be found floating in the European marshes and bogs. However, such nests were not found on the level solfatara-fields; on the contrary there the eggs were scattered over the barren hot crater-field where the stones were covered with a white hue in consequence of the sulphurous vapours. Therefore I ventured the suggestion that large nests are built perhaps in order to prevent the eggs from rolling away, but this assumption proved not to hold for all cases, because

large buildings were also found in such places where the egg would be perfectly safe without a nest.

In the trees and shrubs the clutches ordinarily were deposited on big nests, but in *Pandanus* and in the coconut-palms they were laid as a rule without any material in the leaf-bases.

Elsewhere too, this tern displays no regularity in the choice of nesting-places and nest-building as pointed out by CHASEN. To this point he observes (Bull. Raffl. Mus. 8, 1933 p. 64): "The breeding habits of the Noddy are as variable in Malaysia as elsewhere. Sometimes as in the Keeling Attolon, it makes a nest: at other times the egg is placed on the bare rock".

In a short communication about a trip to the island Kebatoe, near Billiton, KUIPER (De Trop. Natuur 1937, p. 67/68) mentions *Anous stolidus pileutus* to nest there exclusively on the ground, while *Anous minutus worcesteri* only was found nesting in trees and shrubs. A fairly good photograph of a brooding Little Noddy in a shrub accompanies the text.

WORCESTER (Philipp. Journ. Sc. VI, 1911 p. 175) observes: "There were numerous Noddy terns, *Anous stolidus* (LINNAEUS), on the island and they were nesting on the ground among the pursely plants. We did not find any of them nesting on the bare sand".

DELACOUR & JABOUILLE write (l.c. p. 15): "Leur nid est fait d'herbes, d'algues, de plantes marines, de carcasses de poissons ramassés sur le bord de la mer: ses materiaux sont simplement posés les uns sur les autres, sans entrelace, et forment au centre une dépression qui contient l'oeuf unique".

About nesting habits of *Anous s. stolidus* breeding in America, PEARSON (Book of Birds, Vol. I Washington, p. 319) tells: "Of all the American terns only the noddy h a s t h e h a b i t of building its nest in bushes and low trees. Some noddies are exceptions to this rule, however. In some places they enter crevices in rocks to lay their eggs or even use the open ground for this purpose. The nests are substantial structures of twigs, grass, seaweed and similar materials".

WATSON (vide BENT, l.c. p. 304) reported that some nests are occupied anew every year and therefore attain an enormous size. I got the impression that in many cases the same occurs at Gg. Api, because I observed several old nests which seem to have been built up of various layers of nest material. The same author also mentions the stealing of nest material by *A. stolidus*.

BENT (l.c., p. 303/304) writes that the female bird is fed by her mate during the time of nestbuilding, but as soon as incubation has been started, no more feeding takes place.

I am not able to confirm this statement, which, however, does not exclude the possibility that on Gg. Api these birds act in the same way.

It is likely that here a greater number of eggs perish than elsewhere, probably as a result of the extreme heat of the solfatara-fields. Exact data on the temperature are not at hand but in my shelter erected between the nests and young I hardly could stand the heat and I had to move my feet in heavy hobnailed shoes constantly. The vapours from the soil condensed upon my

camera-lenses and the photograph-cases lying on the floor, which in a few minutes became so hot that I could hardly handle them.

The clutch is hatched by male and female equally. The time of incubation is reported to be 35 or 36 days (Bent, l.c. p. 305). The mode of defence of nest or breeding-territory differs considerably and seems more to be dependent on the individuality of the different birds than to the degree of incubation of the clutch. Sometimes the birds took wing when we approached the nest and still kept at a considerable distance; on the other hand we could not rarely draw quite close to the nest and even caress head and wings of the occupant. Once I took up a chick, while the adult stepped upon my hand. The mate of this bird, however, was so shy under the same circumstances that it left the nest when we were yet at a distance of 10 meters or more. Shrieking, it flew at us, swooped down at our heads, and returned immediately to attack us in the back. This one and also other birds touched our head several times.

In the *Pisonia* wood it happened several times that quite unexpectedly an *Anous* swooped down and attacked us shriekingly. In one case we were able to catch the rash bird with the bare hand. The sound produced during such attacks is a loud "akèggg-akèggg" or a harsh "kraaaa-kraaaa".

This dissimilarity in behaviour was also noticed by Watson (Bent l.c., p. 304): "After the egg is laid a marked change appears in the behaviour of both the male and the female. The birds will now attack even a human intruder, and their defence of the nest against their own kind becomes even more strict than before. Oftentimes the birds will sit on the egg and allow themselves to be caught, striking viciously all the while with their long, keen, pointed beaks. Individuals vary greatly in this respect".

Probably the young birds are able to fly at an age of about 6 weeks. Before that time they stay at or near the nest. If they wandered from home, as was the case when they were disturbed by our approach, and lost their way home between the big lava blocks, they were, nevertheless, fed by the adults and flourished just like the other specimens. A similar observation made by Watson (Bent l.c., p. 305) may be quoted here: "In many cases these young birds cannot get back into the nest. Under these circumstances they remain near the nest-locality, and the parents on returning first alight on or near the nest and later hop to the ground and feed the young bird. It is interesting to speculate upon the method of recognition between parent and young. There can be no doubt at least of an accurate functional recognition. Since the Noddy is always silent when contented, the evidence is good that recognition occurs wholly in terms of vision. Whether recognition of young (or of mate by mate) would take place outside of the nest locality is a problem which ought to be solved".

In the feeding process the young bird snatches the food from the beak of the adult after the food has been brought into the lower bill and throat. In the cases examined by me, the food consisted of fry and squids. **H.**

Sterna anaetheta anaetheta SCOP.

Sterna anaethetus SCOPOLI. Del. Flor. et Faun. Insubr. 1786, p. 92 (Panay Island, Philippines).

Material:

Cat. Nos. Btzg. Mus.	Sex		Culmen	Bill from gape	Wing	Tail
9290	?	pullus	—	—	—	—
9291	?	pullus	—	—	—	—
9292	♀	pullus	27	41	—	—
9293	♂	pullus	28,5	43	—	—
9294	♀	adult	41,5	53,5	270	215
9295	♂	adult	41,5	54	274	203
9296	♂	adult	41,5	52	271	193
9297	♂	adult	43	51,5	265	205
9298	♀	adult	42	53	273	198
9299	♀	adult	41,5	52	267	202
9300	♀	adult	40	50	262	205

The numbers 9290 and 9291 are nestlings in down. Down coverts are very dark brownish grey with pale yellow brown tops and grey base. The nestlings are yellowish grey on the belly. Iris darkbrown, bill deep grey to black, legs deep grey.

Number 9292 a much older pullus, already partly in feathers. Throat and forehead still in speckled down, crown black with greyish white stripes. Quill-feathers brownish black, rest of feather covering brownish black with pale reddish brown tops. Colour of bare parts as in the preceding specimens.

Number 9293 almost fledged and entirely in feather covering.

Throat, cheeks and the whole of the underparts white. Upperside of head and lores dark greyish brown with light stripes, superciliary stripes and forehead grey with somewhat darker specks, neck and shoulders grey but no light margins on the feathers. The rest almost uniform dark brownish grey with some traces of the pale reddish brown marking of number 9292.

All the other birds are full-grown, in breeding plumage with dark brown iris, black bill and black to deep grey legs. The measurements of wings of the Gg. Api birds are larger than stated by STUART BAKER for British India (Fauna British India VI, p. 141), but they tally with those mentioned by MEISE for Sangiang (Journ. f. Ornith. 1930, p. 193 - 194). Nor can I find any differences between a series of adult birds of Java belonging to the collection of Dr. M. BARTELS, some birds of Billiton and Ceram in the Museum Buitenzorg and the birds of Gg. Api. Some specimens of Malacca (Coll. Raffles Museum Singapore) are much lighter, but have probably faded. Number 9293 is remarkable for lacking the light margins on the shoulder feathers. A somewhat younger

pullus of Java in the collection of Dr. Bartels is much lighter, the head being more distinctly marked and also much lighter. A somewhat older specimen of Benkoelen in the collection of the Buitenzorg Museum is also lighter with distinctly marked shoulders, but bears a greater resemblance to the marking of the head of the Gg. Api bird. If there is a constant difference in the juvenile plumage of this species between the western and the eastern part of the Archipelago, is a question which had to be left unsettled, owing to the want of material which I had at my disposal. For the present we shall have to accept that *Sterna anaetheta* is represented in the Indian Archipelago by one single subspecies. **v. B.**

The Eggs.

The egg is very pretty. The dull or light gleaming shell shows on a light to dark cream coloured background a number of spots of various shape and size. All the eggs examined by me exhibit beside dark primary dots, a number of lighter secundary speckles.

In general the marking is evenly divided over the entire shell and generally speaking the spots do not converge, with the exception of a few eggs where I noticed a concentration of most spots round the blunt pole of the egg forming there a little circle.

The secondary spots vary from light to a dark ashgray, while the primary speckles have a light to darkbrown chestnut hue, sometimes varying to the colour of amber or drawing to black. Though the colour of these eggs resembles those of *Anous stolidus*, yet one may tell them apart, because they vary not only in size but also in markings, the latter being usually more concentrated than those found on the clutch of *Anous*.

Some eggs are "flamed", making the impression as if they have been "smeared" with a paint-brush. The egg portrayed on pl. 31 fig. 3, right corner below, ows its dark covering probably to influences from the outside, i.e. from the solfatara field, where I actually found it.

In 20 eggs the length varied from 42 - 51 mm and the width from 31.5 -35.5 mm; the largest egg measured 51: 35, the widest 45: 35,5 mm. **H.**

Biology.

The number of this dark-winged, rapid flighted tern was considerably smaller than that of *Anous stolidus,* even taking in consideration that many specimens were hidden among the lavablocks or kept perched on the nest or in the cavities.

During our stay the birds were almost always flying in couples, while in breeding we did not observe a definite inclination to the formation of colonies.

Contrary to *Anous,* which apparently feels itself at home in any surrounding, *Sterna anaetheta* gives the impression to be extremely particular about its habitat. At Gg. Api life concentrated in a part of the old lava bed, which was bare of all vegetation.

The birds appeared to be rather shy and easily startled. In no way they could be approached. At our approach they uttered a plaintive sound "wouweee-wouweee" or "wouweee—krrr" or "kèkè—krrr", circling wildly around us but carefully avoided to come too near. The quietly perching birds uttered a soft cooing sound like "kurr - kurr - kurr" or a plaintive "uwwww—uwwww".

As remarked before, this tern does not breed in colonies but in some cases several couples were found breeding in such surroundings which elsewhere were not frequented at all.

At Gg. Api they usually were nesting between *Anous stolidus* and like *Phaeton rubricauda* on the bare floor of clifts and in cavities without using any nesting material, often so deep that on no account the clutch, consisting of a single egg, could be detected. Only a few times we found the eggs lying uncovered between the rocks.

The entrance to the nest is often rather intricate. So we sometimes were able to catch a bird as it tried to escape, when disturbed by our walking over-head, and could not free itself in time from the narrow mouth of the cavity.

One nest was found in a cavity in a steep slope, that in about horizontal direction had a depth of more than a meter.

Only a few times I found the egg not in a hole, but only between the stones. That *Sterna anaetheta* not always shows such a marked preference for cavities as nesting places, has been observed by the author at a breeding colony near Bawean (Java-sea) where all eggs were deposited on a coral reef and on level ridges, though the conditions for hole breeding also existed.

It took some time and a lot of trouble to discover the young of this species. Then it was another problem to snatch the fluffy balls from between the rocks.

The bigger specimens were scarcely visible too, obviously profiting of the great safety offered by the favourable nest-site chosen by the adults. Only twice we were able to collect such birds and these were the only occasions to get a closer view of them. From the fact that one of these almost full-fledged young was found in a nesting cavity it may perhaps be concluded that the young birds probably keep to the nest till they are fully able to fly, which may be the case at an age of about six weeks. Not a single flying young bird could be observed.

Owing to the lack of young birds and because all stomachs of the collected adult specimens were empty, no data could be obtained about feeding habits and the nature of the food, but it seems probable that the latter resembles the diet of all other birds at Gg. Api. Observations by WETMORE, point in this direction. This author, according to BENT (U.S. Nat. Mus. Bull. 113, p. 289), noted the following: "Of five stomachs examined one was entirely empty. Fish remains were present in all the other stomachs and amounted to 70 %, one species was identified as a filefish (*Alutera* sp.) Mollusks (25 %) were represented by a gastropod and a cephalopod (*Spirula australis*) the latter one of the few of that order bearing a shell, that exist to-day. Miscellaneous matter (5 %) consisted of a moth and a small echinoderm. Fish and marine mollusks

form the large bulk of the food, and under present conditions the birds are to be considered harmless, as the fish eaten are not of economic importance".

BENT citing AUDUBON (l.c. p. 285) remarks: "This species rarely alights on the water, where it seems incommoded by its long tail".

And: "......that it never dives headlong and perpendicularly, as the smaller species are wont to do, but passes over its prey in a curved line and picks it up".

I did not succeed in observing specimens of this tern swimming or even bathing. **H.**

Sterna fuscata nubilosa SPARRM.

Sterna nubilosa SPARRMAN Mus. Carls. fasc. 3, 1788, No. 63 (Finland, errore = "India Orientalis", according to SUNDEVALL).

Material:

Cat. Nos. Btzg. Mus.	Sex	Culmen	Bill from gape	Wing	Tail
9269	♀ juv.	31,5	47	270	105
9270	♂ juv.	34	48	275	113
9271	♂ juv.	34	46,5	287	117
9272	♀ juv.	33	45	292	128
9273	♀ juv./ad.	38	51	(282)	158
9274	♂ ad.	41	55	(285)	166
9275	♀ ad.	39	52	(281)	(155)
9276	♀ ad.	40	55	277	(137)
9277	♂ ad.	42	58	280	165
9278	♂ ad.	41	58,5	282	168
9279	♀ ad.	42	53,5	290	168
9280	♀ ad.	40	54	285	(162)
9281	♀ ad.	41,5	53	(283)	(158)
9282	♀ ad.	40	55,5	280	164
9283	(♀ ad.)	42	53,5	294	165
9284	♂ ad.	41,5	53,5	283	177
9285	♂ ad.	42	55	293	175

The specimens 9269 - 9272 are in blackish brown juvenile plumage, but already fledged. The feathers of back, tail, wing coverts and under secundaries with white points. A white spot on belly. Iris deep brown, bill and legs black.

Number 9273 already in adult covering, but shoulderfeathers have white tops. For the rest the plumage resembles that of numbers 9274 and 9275. These birds have a white striped crown and lores, which is typical of the "winter" plumage.

Number 9281 has traces of these stripes, but has, besides this, pale tops on the shoulder feathers. Probably this is a full grown young bird. The ovary already rather well developed. Wings of these last four birds in moulting.

All the other adults still in brooding covering with dark crown and lores. Two of these, ♀ ♀ with well developed ovaries have dark spots on throat. Bill black; iris deep brown; legs black or very deep grey. The "Rassenkreis" *Sterna fuscata* urgently needs revising. I followed the division of J. L. PETERS in his "Checklist of Birds of the World", which in his own words is only "tentative". As material of comparison I had the disposal of a small series of *Sterna fuscata serrata* WAGLER of Lord Howe Island in the collection of the Australian Museum at Sydney. Two adults in this series are larger (Culmen 44 - 46); bill from gape 58 - 60; wings 296 - 300; tail (192 - 196). The juvenile specimens of *serrata* have a lighter coloured breast while the ventral spot is less distinct. **v. B.**

The Eggs.

During my visit to Gg. Api I found no clutches of these terns. From the literature on the subject we learn that the clutch usually consists of only one egg. DELACOUR & JABOUILLE (Trav. Serv. Océanogr. Indochine, 3e Mém. 1930, p. 11) give the following measurements of two eggs of *S. fuscata infuscata:* 47: 37 and 55: 34 mm. **H.**

Biology.

The number of this lively, sociable tern amounted to four or five hundred. Although morphologically it closely resembles *Sterna anaetheta,* in biological respect it differs widely from this species. While the latter tern keeped at the western slopes of Gg. Api, between the lavablocks, *Sterna fuscata* lived exclusively at the solfatara fields and on the crater bottom on the bare places between the *Paspalum* vegetation. On each of the three big solfatara-fields near the crater, devoid of any vegetation, we regularly could observe a number of specimens.

As a rule this species proved to be not too shy and repeatedly we succeeded in approaching the perching birds to within a distance of some meters.

Therefore my observations do not agree with the notes of BENT (Bull. U.S. Nat. Mus. 121, 1922, p. 287). He writes: "The bridled tern so closely resembles its near relative, the sooty tern, that it can hardly be distinguished from it in life by the casual observer".

Often the alarm-cry of a single bird was enough to startle the whole flock and after first being given by a single bird, was taken over by the flying flock while it steered for the sea. This cry sounded like a harsh and shrill "krr—krrr" or "awèhwèhwèh—awèhwèhwèh". Not rarely the other "rookeries" followed the first flock and a number of *Anous stolidus,* highly disturbed by the pandemonium, and not trusting themselves any longer on the ground, joined in flight. These manoeuvres happened at our approach as well as when we kept far away from the resting-places. Often we heard the alarm at moonlight nights, a fact also mentioned by BENT (l.c. p. 286). "One can hardly make himself heard in the rookeries by day and it is difficult to sleep near them at night".

During daytime the birds at the solfatara fields were chiefly occupied in trimming their feathers. Occasionally, however, a number of them were engaged in what seemed a rather curious act, which is worth mentioning.

Some 3 to 6 birds were trodding in a large circle with trailing wings and the head poised obliquely at an almost horizontal position.

Ovaria and testes of the examined birds were all in rest, and the feathering did indicate a passed breeding season. Therefore it seems difficult to connect this behaviour with mating, which seems the more improbable with a view on the presence of a number of full-fledged young birds at the island.

No eggs of *Sterna fuscata* were found at Gg. Api, but notwithstanding the fact that not a single clutch or even a small young has been found, this species too may be safely ranged among the breeding birds of Gg. Api. This I deduced from the fact that a number of mutilated juvenile birds were found at the bottom of the crater, where they were fed by the adults. It seems likely that these tumbled down at an age where they were not yet able to fly or had been hatched in the crater and were mutilated when trying to reach the open.

In this connection Beebe suggested that at the Island of Daphne a number of *Sula nebouxi,* hatched at the bottom of a crater, were hurt in an attempt to leave this place.

The feathers of the "crater-terns" had developed normally, but it seems probable that finally they will have starved as they certainly were not able to leave the crater.

A short reference of the literature concerning the breeding of this tern at other places follows below.

Worcester (Philipp. Journ. Sc. VI, 1911, p. 171) mentions the breeding in great numbers of *St. fuscata* at the Phillipines. At the same time he observed eggs and big young birds.

Delacour & Jabouille (l.c. p. 11) relate that the nests without any nest-material were assembled in immense colonies in the sand, upon the bare rocks and small dunes. The eggs were often so close together that it was difficult to walk between them without treading upon the eggs.

Audubon (vide Bent l.c., p. 279) too, mentions the vast rookeries of this gregarious bird. Concerning this he remarked: "On landing I felt for a moment as if the birds would raise me from the ground, so thick were they all around and so quick the motion of their wings".

Pearson (vide Bent, l.c. 319) writes about *S. fuscata:* "The eggs, usually one to a nest, are laid in slight hollows scooped in the sand. The sooty is one of the "egg-birds" of the Tropics, and thousands of its eggs are gathered for food by natives of numerous and little-known islands of the sea".

During my visit to Gg. Api the number of young was rather small. I am not able to detect the cause to which this may be attributed. As presumed for *Anous stolidus,* it probably may be caused by the great heat at the solfatara fields where this tern exclusively was found. Here, too, it seems extremely unlikely that men would have exterminated the whole amount of eggs, as a

great number of eggs and young of *Anous stolidus,* and also of other species which breed on the ground, were present. Moreover, a single looting of the nesting grounds, will not affect the tern-colonies in this way, for, as a rule, those birds produce new eggs and the incubation is started again.

The wrecking of quantities of eggs apart from the influence of solfatara seems, however, to occur elsewhere too, as mentioned by WORCESTER (l.c. p. 171), who remarks: "Eggs were scattered around in large numbers, but many of them were bad ones, which had failed to hatch".

The disgorged food is transmitted to the young through the hardly opened beak of the parent. Data on the composition of the food are not available, as the collected birds all had an empty or nearly empty stomach and crop. In some cases I saw the young birds fed with small fish.

According to DELACOUR & JABOUILLE (l.c. p. 12) the food consists of cephalopods and crustaceans, caught at the surface of the sea.

In begging, the young is slightly clapping the tip of the bill and chirping weakly, making a squeaking sound. Repeatedly I saw several adult birds pursuing a single young, seemingly urging the food upon it. If the latter tried to escape, the adults often trod upon their benjamin in their eagerness to overtake it.

This prevalent feeding-instinct seems to point to a discordance in the numerical relation between old and young birds, and is, moreover, illustrated by the fact that during my stay at the island only about 10 young were observed.

On this point too, it is not easy to solve the problem in a satisfactory way.

H.

Hypotaenidia philippensis xerophila nov. subspec.

Material:

Cat. Nos. Btzg. Mus.	Sex	Culmen	Wing	Tail
12364 (Type)	♀ ad.	26	132	49
12365	♀ ad./juv.	27	123	55
12366	♂ ad. (±)	29	131	56

Type: ♀ ad. Cat. Number 12364 Mus. Btzg. Gg. Api, 9 Aug. 1938; leg. A. HOOGERWERF. Terra typica: Gg. Api.

Diagnosis: This subspecies is especially characterized by the very small measurements. Colours resemble those of *H. philippensis australis* PELZELN fairly well, but they are brighter. Besides the throat is lighter, almost white, even the rust-coloured brown of the nape is deeper, while the orange brown coloured bar of the breast is retained also in the adult covering. Over this bar the black and white marking of the underparts is continued for about 1 cm. Iris red. Bill: upper mandible deep grey; under mandible flesh-coloured; legs light brownish grey to light grey.

The type had a swollen ovary; largest egg about ½ cm in section. The two paratypes are not yet full-grown. In number 12365 the orange brown bar on the breast with a narrow stripe of black and white feathers. Under this bar a broad grey stripe. In number 12366 this stripe has disappeared except for some little spots.

For comparison there follow some measurements of *H. p. australis* Pelzeln of Australia, *H. p. chandleri* (Math.) of Celebes and *H. p. wilkinsoni* (Math.) of Flores.

australis.

	Sex	Culmen	Wing	Tail
Austr. Museum 30113	♂ juv./ad.	28	141	71
,, ,, 30112	♀ juv./ad.	29	139	74
,, ,, 16785	? ± ad.	39	146	(53)
,, ,, 30111	♂ ad.	34	152	76

chandleri.

	Sex	Culmen	Wing	Tail
Mus. Btzg. 4704	♀ ad.	30	138	66
,, ,, stuffed specimen	? ad.	29	139	66
,, ,, 13567	♂ ad.	30	138	73

wilkinsoni.

	Sex	Culmen	Wing	Tail
Zool. Mus. Berlin 30.189	? ad.	29	139	64
,, ,, ,, 30.1179	♀ ad.	29	145	73

In the diagnosis of *H. p. wilkinsoni* (Bds. Austr. I, 1911, p. 198) Mathews gives the following measurements: Culmen 32 - 33, wing 155 - 157. I am in doubt of the subspecific difference between *chandleri* and *wilkinsoni,* but owing to the want of material at my disposal I cannot take a definitive conclusion.

The new race is a typical dwarf-form, that perhaps arose on Gg. Api under influence of the extremely unfavourable circumstances. **v. B.**

Halcyon sancta sancta Vig. & Horsf.

Halcyon sanctus Vigors and Horsfield Trans. Linn. Soc. 15, 1827, p. 206 (Australia).

Material:

Cat. Nos. Btzg. Mus.	Sex	Culmen	Wing	Tail
9301	♂ juv.	25	87	60
9302	♂	35	87	62
9303	♀	37	88	62

Three, not yet or not entirely matured specimens are concerned. Number 9301, a juvenile bird with an entirely yellowish brown belly, has very short bill. Iris deep brown, bill black with light flesh-coloured base of lower mandible; legs grey. Contents of stomach: pulverized rests of insects.

Migrant from Australia. **v. B.**

Coracina novaehollandiae melanops (Lath.).

Corvus melanops Latham, Ind. Orn. Suppl. 1801, p. 24, (N.S. Wales).

Material:

Cat. Nos. Btzg. Mus.	Sex	Culmen	Wing	Tail
8947	♀	23	177,5	147

The only specimen, collected of this species, is a ♀ in juvenile covering. Wings still have distinct traces of the cream coloured first covering (vide Stresemann: Nov. Zool. XXI, 1914, p. 123 - 124). Iris dark brown; bill black with grey base of lower mandible; legs very deep blackish grey. Ovary very small. Stomach empty.

Migrant from Australia. **v. B.**

Zosterops palpebrosa lettiensis Finsch.

Zosterops lettiensis Finsch, Notes Leyden Museum, Vol. 20, 1898 - 1899 p. 136 (Letti).

Material:

Cat. Nos. Btzg. Mus.	Sex	Culmen	Wing	Tail
9097	♂	12	60,5	51
9098	♂	11,4	58	48
9099	♀	11,4	57	51

One of the ♂♂ distinctly shows the yellow longitudinal stripe on the abdomen, mentioned by Finsch in his original description of this subspecies. The other two specimens lack this stripe, just as the three specimens of Wetar (coll. Schädler: Rijks Museum Nat. Hist. Leiden, Number 3, 5, 6). The wings and the culmen of birds from Wetar are somewhat smaller than those of Gg. Api, viz. wings: 56; 56; 56,5; culmen 10,7; 11,4; 11,4.

In his original description Finsch gives 60 mm for wing, but his description is only based on one single bird.

Iris light brown; bill: upper mandible black; lower mandible bluish grey; legs bluish grey. Contents of stomach little green fruit-stones. In his revision (Mitt. Zool. Mus. Berlin 17, 2, 1931.) Stresemann says that *lettiensis* belongs to the "Rassenkreis" *Zosterops citrinella*. Recently the same author, however, proved, that the "Rassenkreis" in question should be united with *Zosterops palpebrosa* (Journ. f. Ornith. 87, 1939, p. 160). **v. B.**

POSTSCRIPT.

The second author expresses his thanks to Miss Dr. J. Ruinen who assisted at the translation of his part of the present paper.

Readers may be interested in the fact that Murphy gives an explanation of the word b o o b y, as follows: "The name booby comes from the Spanish b o b o, meaning a dunce, and the lethargic behaviour and stupid expression of the bird make the name seem appropriate". (Nat. Geogr. Mag. LXXIV, no. 2, Washington, Aug. 1938). **H.**

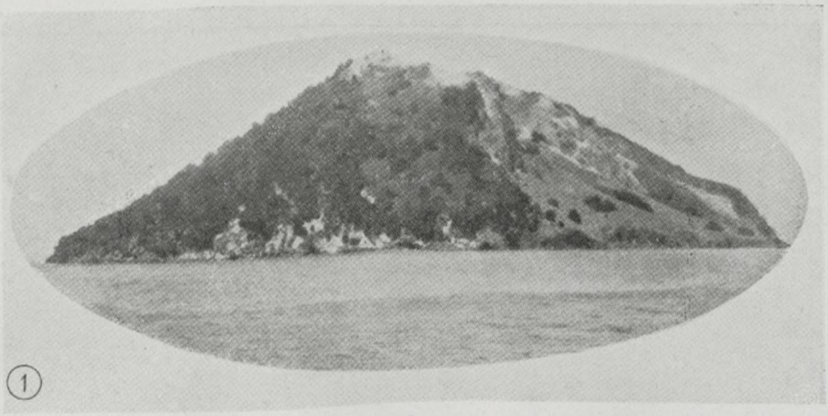


Photo Dr. Ph. F. Kuenen.

A. C. V. van Bemmel & A. Hoogerwerf:
The Birds of Goenoeng Api.

Fig. 1. Goenoeng Api, seen from the West. — Fig. 2. Part of the inhospitable West side of the volcano.

[*Photographs on pls. 17 - 29 by A. Hoogerwerf, and on pls. 30 - 34 by F. Huysmans jun.*].

A. C. V. VAN BEMMEL & A. HOOGERWERF:
The Birds of Goenoeng Api.

Fig. 1. One of the highest points of Gg. Api. Left in the centre a solfatara-field along the craterwall with resting *Sterna fuscata*. — Fig. 2. "Rising directly from the Ocean bottom, 4000 meters deep". Steep slope, partly grown with dense *Pisonia*-complexes.

A. C. V. VAN BEMMEL & A. HOOGERWERF:
The Birds of Goenoeng Api.

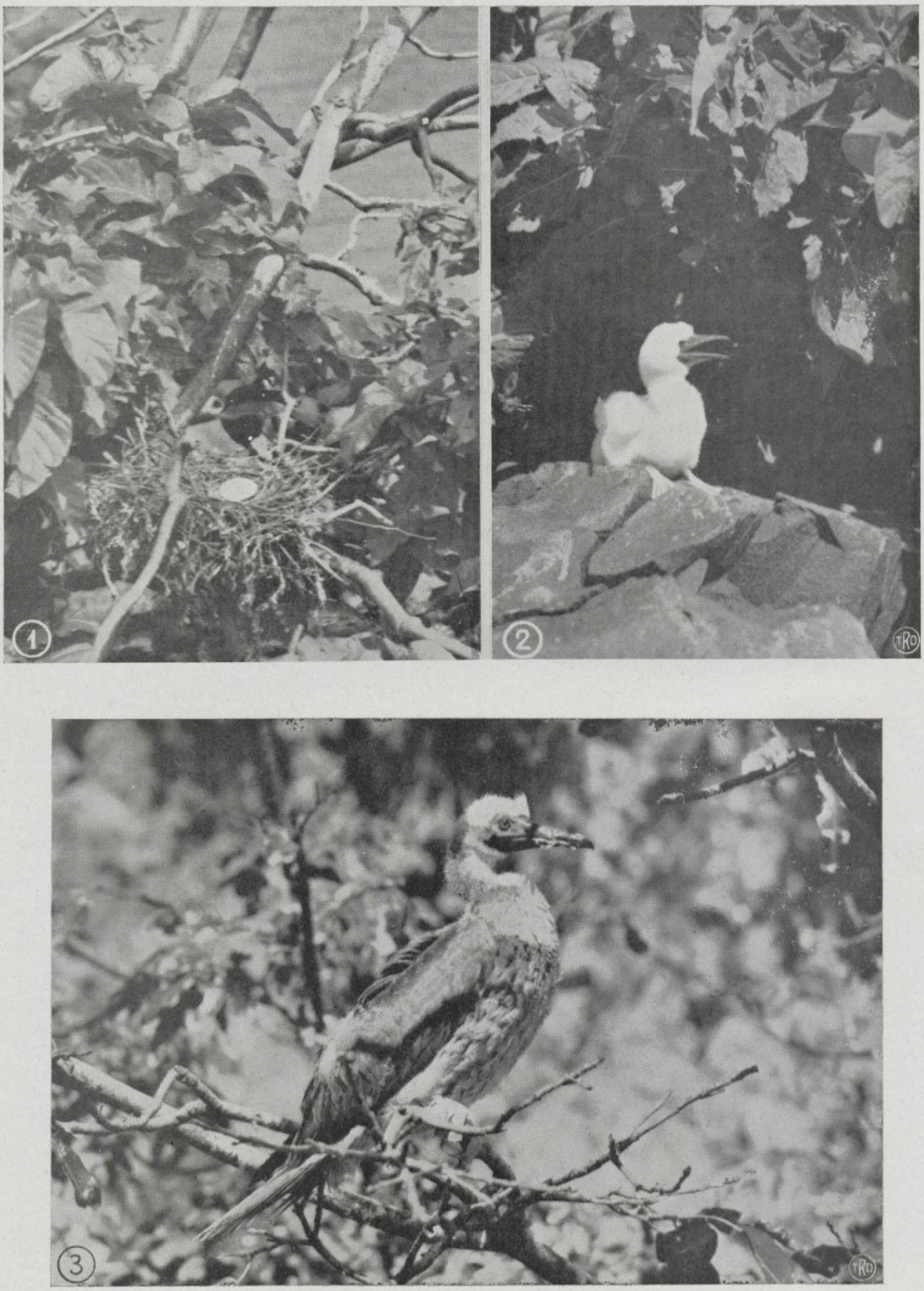
Fig. 1. *Fregata m. minor* feeding its young. — Fig. 2. Small young of the frigate-bird, placed on a lava-block by the author. — Fig. 3. Breeding female of *Fregata m. minor* in a partly leafless *Ficus*.

A. Ç. V. VAN BEMMEL & A. HOOGERWERF:
The Birds of Goenoeng Api.

Fig. 1. Male of *Fregata m. minor* with inflated breast-pouch in a *Pisonia* on the future nest-site. — Fig. 2 - 3. Young of *Fregata m. minor*; the right one is about 4 weeks, the left bird circa 7 weeks old.

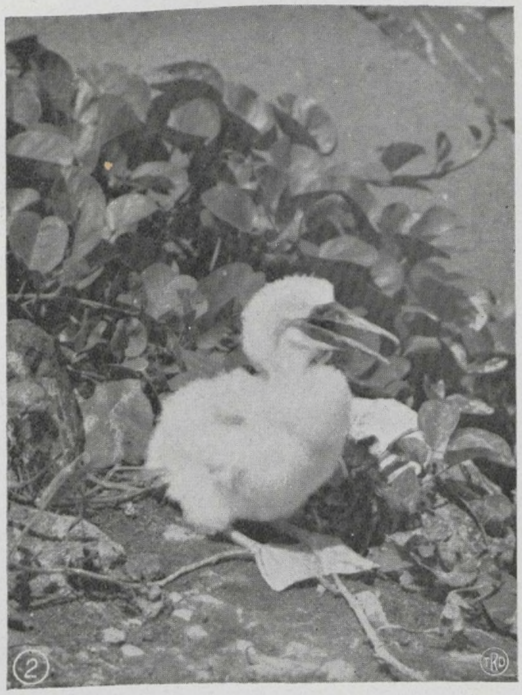
A. C. V. VAN BEMMEL & A. HOOGERWERF:
The Birds of Goenoeng Api.

Fig. 1. Breeding *Sula sula rubripes*; the bird in the foreground is still in the juvenile stage. — Fig. 2. The same nests; the mate of the "juvenile" bird of fig. 1 was a specimen in adult feathering. In the right corner a young frigate bird.



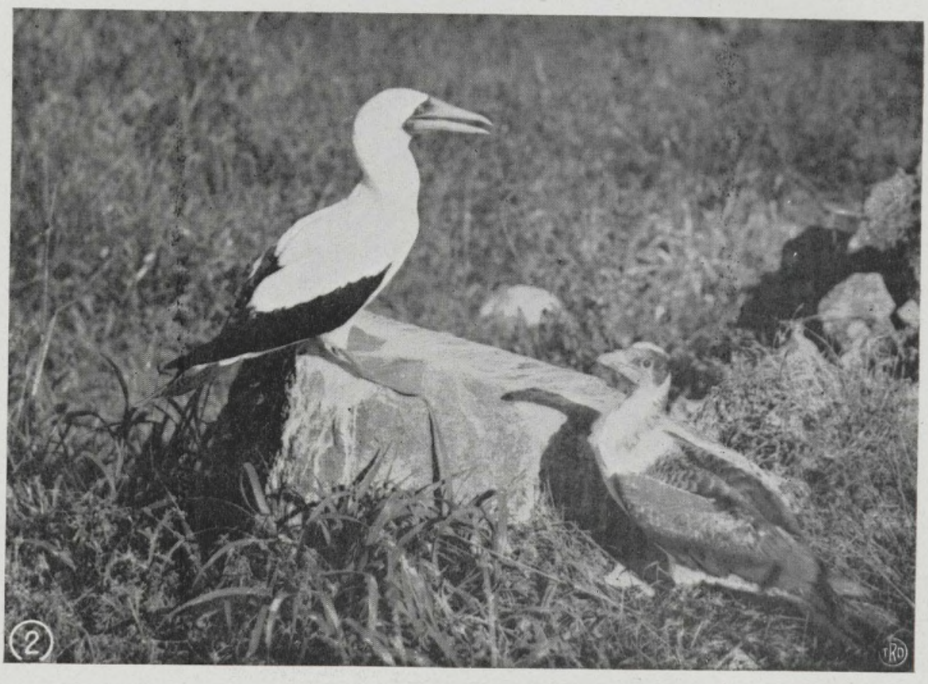
A. C. V. VAN BEMMEL & A. HOOGERWERF:
The Birds of Goenoeng Api.

Fig. 1. Nest of *Sula sula rubripes* in a *Pisonia*-tree. — Fig. 2. Small young of the red-footed booby, placed on a lava-block by the author. — Fig. 3. Nearly full-fledged young of the same species.



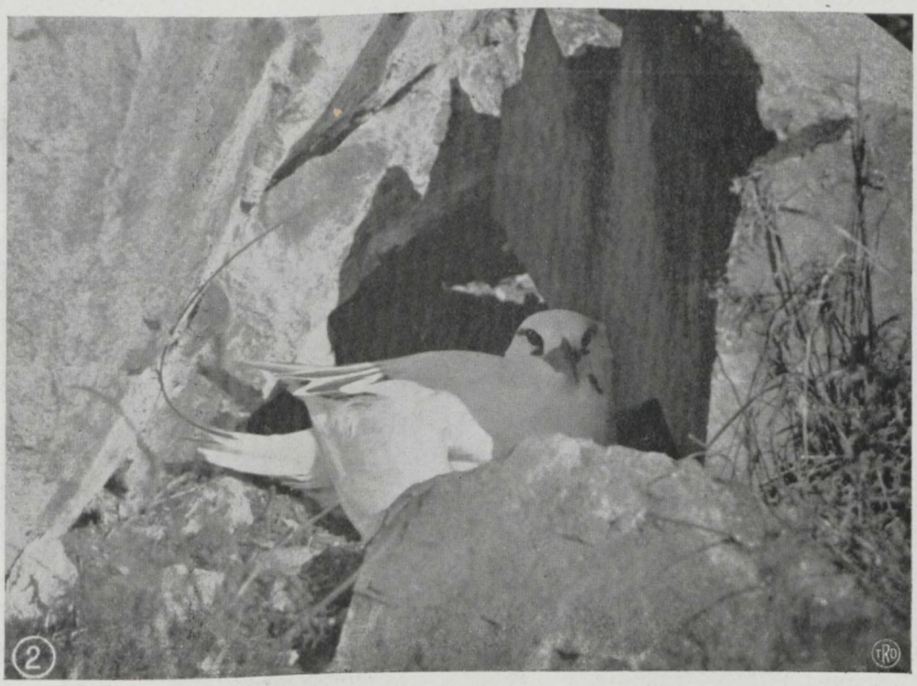
A. C. V. VAN BEMMEL & A. HOOGERWERF:
The Birds of Goenoeng Api.

Fig. 1. The egg of *Sula dactylatra* amidst a lot of small pebbles, at the foot of a weather-beaten lava-block. — Fig. 2. Young *Sula dactylatra* in dawn at the nest-site amidst *Ipomoea pes caprae*.



A. C. V. VAN BEMMEL & A. HOOGERWERF:
The Birds of Goenoeng Api.

Fig. 1. Two wholly and one nearly full-fledged young of *Sula dactylatra bedouti*. — Fig. 2. Adult *Sula dactylatra*, just returned to its young and before feeding started.



A. C. V. VAN BEMMEL & A. HOOGERWERF:
The Birds of Goenoeng Api.

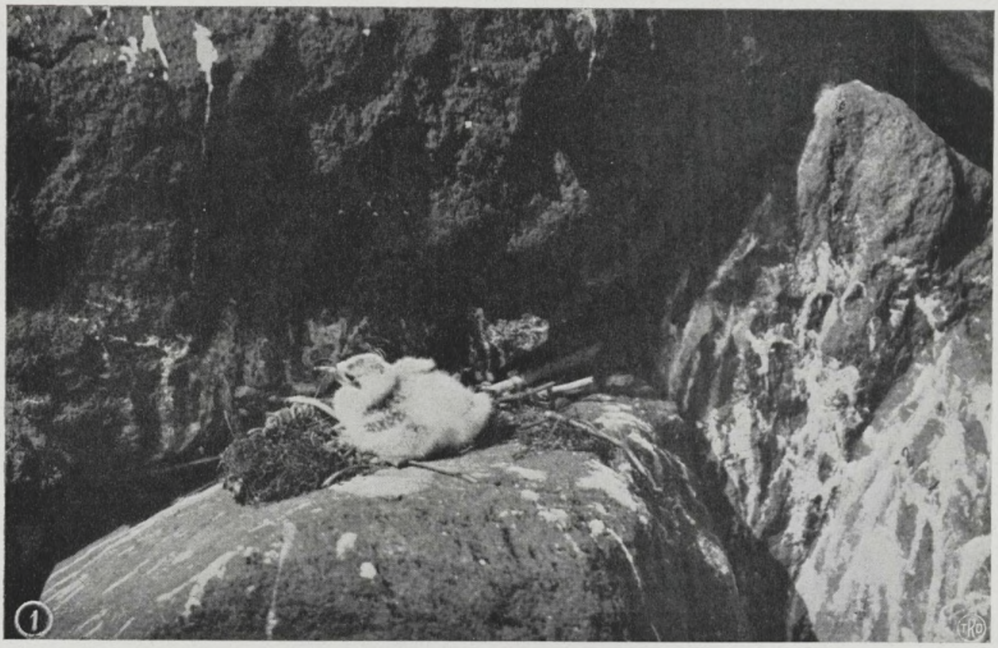
Fig. 1. Nearly full-fledged young of *Phaeton rubricauda westralis,* placed on a lava-block next to the nest-hole. — Fig. 2. One of the rare cases when the nest was exposed to sunshine part of the day.

A. C. V. VAN BEMMEL & A. HOOGERWERF:
The Birds of Goenoeng Api.

Fig. 1. *Sula leucogaster plotus*; adult feathering not yet fully developed. — Fig. 2. *Anous stolidus pileatus* with small chick near the place where it was hatched.

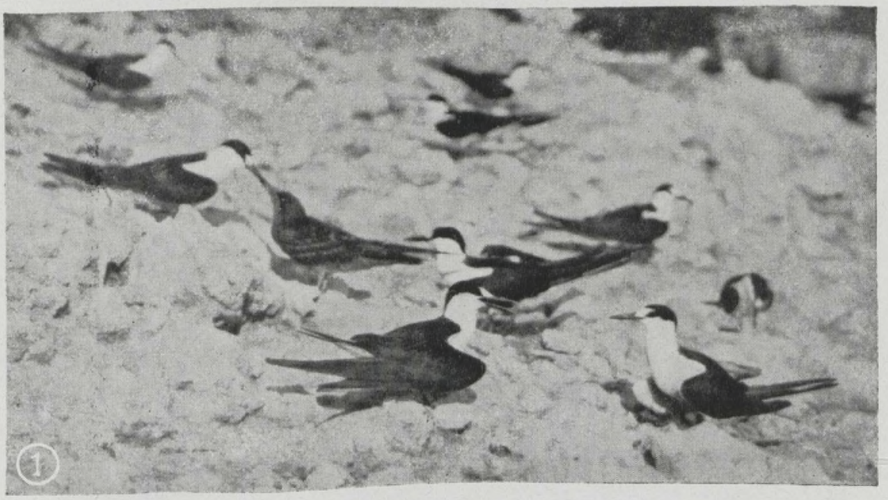
A. C. V. VAN BEMMEL & A. HOOGERWERF:
The Birds of Goenoeng Api.

Fig. 1. Tree-nest of *Anous stolidus* with small young in the white phase. — Fig. 2. A similar chicken on a lava-block.



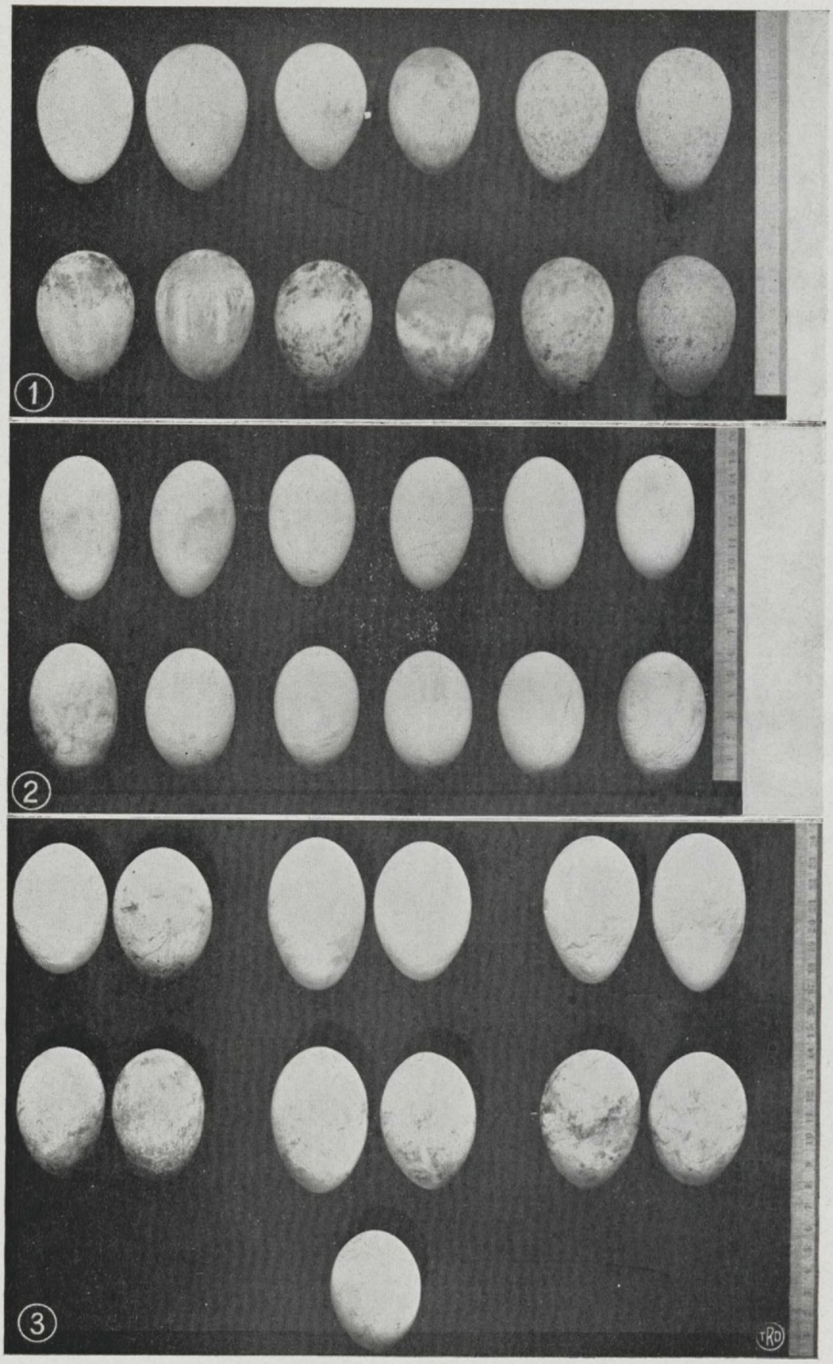
A. C. V. van Bemmel & A. Hoogerwerf:
The Birds of Goenoeng Api.

Fig. 1. When the young of *Anous stolidus* grows, the feathering becomes darker. — Fig. 2. Tree-nest of the Noddy with young in the brown phase. — Fig. 3. The Noddy feeding its young.



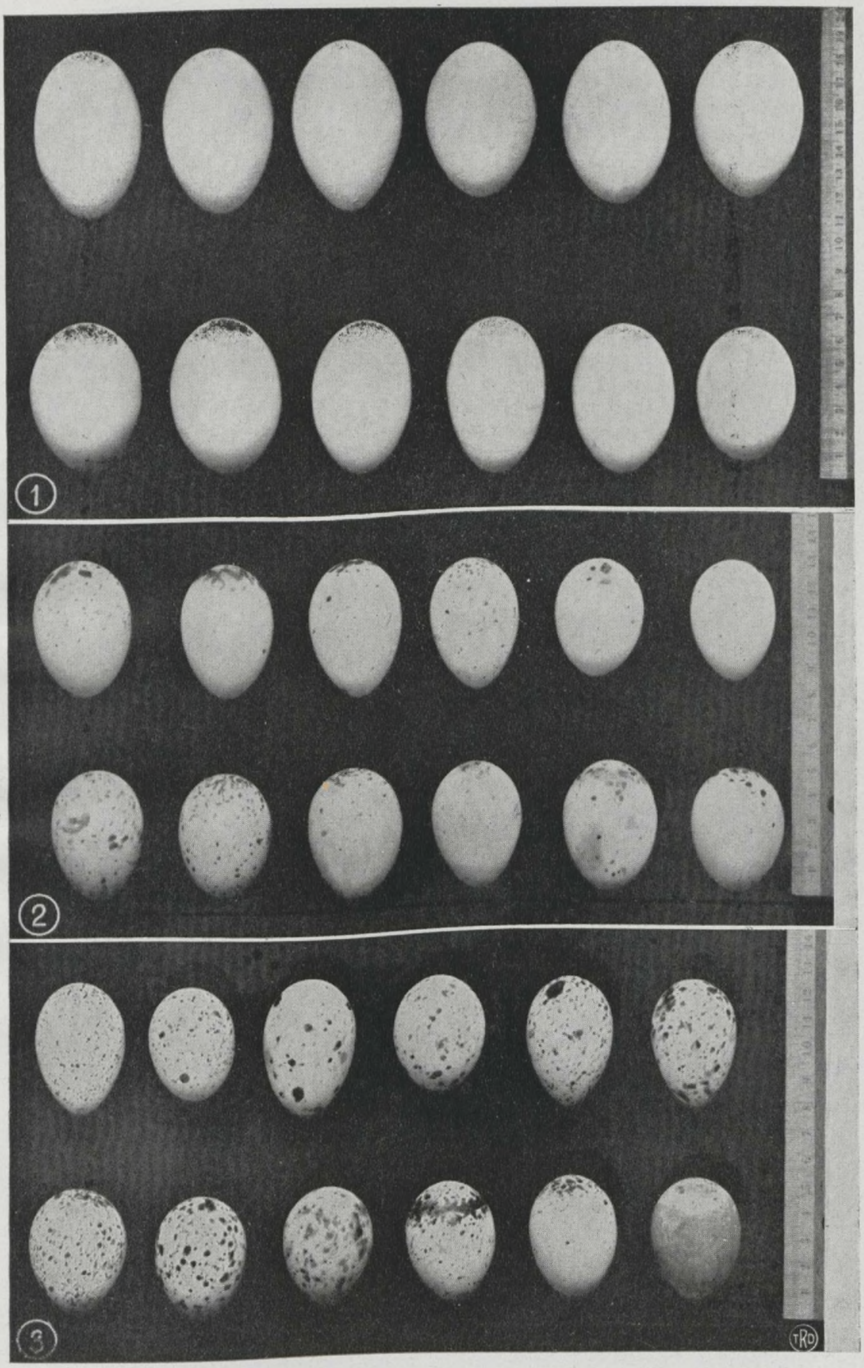
A. C. V. VAN BEMMEL & A. HOOGERWERF:
The Birds of Goenoeng Api.

Fig. 1. *Sterna fuscata nubilosa*, feeding. — Fig. 2. Colony of the same species on a solfatara-field, in the neighbourhood of the crater. In the centre a „begging" young.



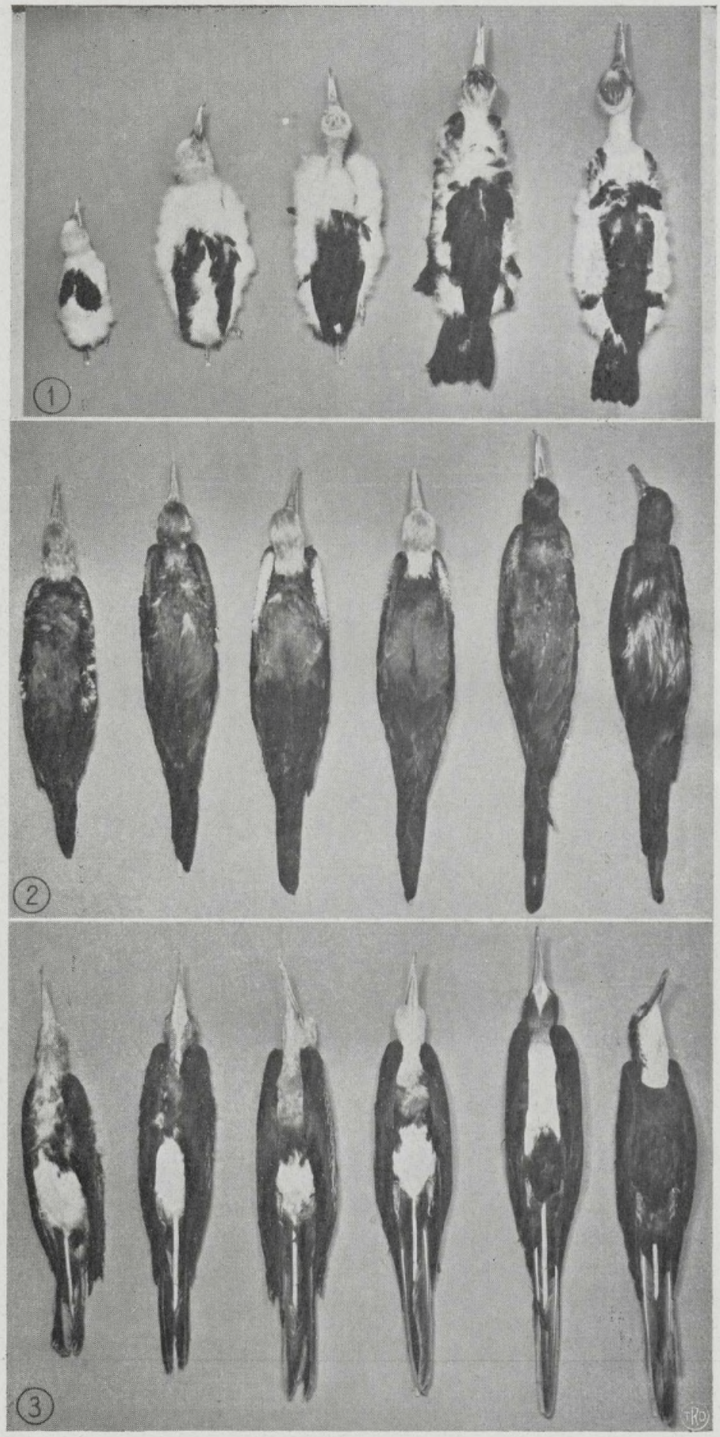
A. C. V. VAN BEMMEL & A. HOOGERWERF:
The Birds of Goenoeng Api.

Fig. 1. Twelve of the most divergent clutches of *Phaeton rubricauda westralis.* — Fig. 2. Idem of *Sula sula rubripes.* — Fig. 3. Seven clutches of *Sula dactylatra bedouti.*



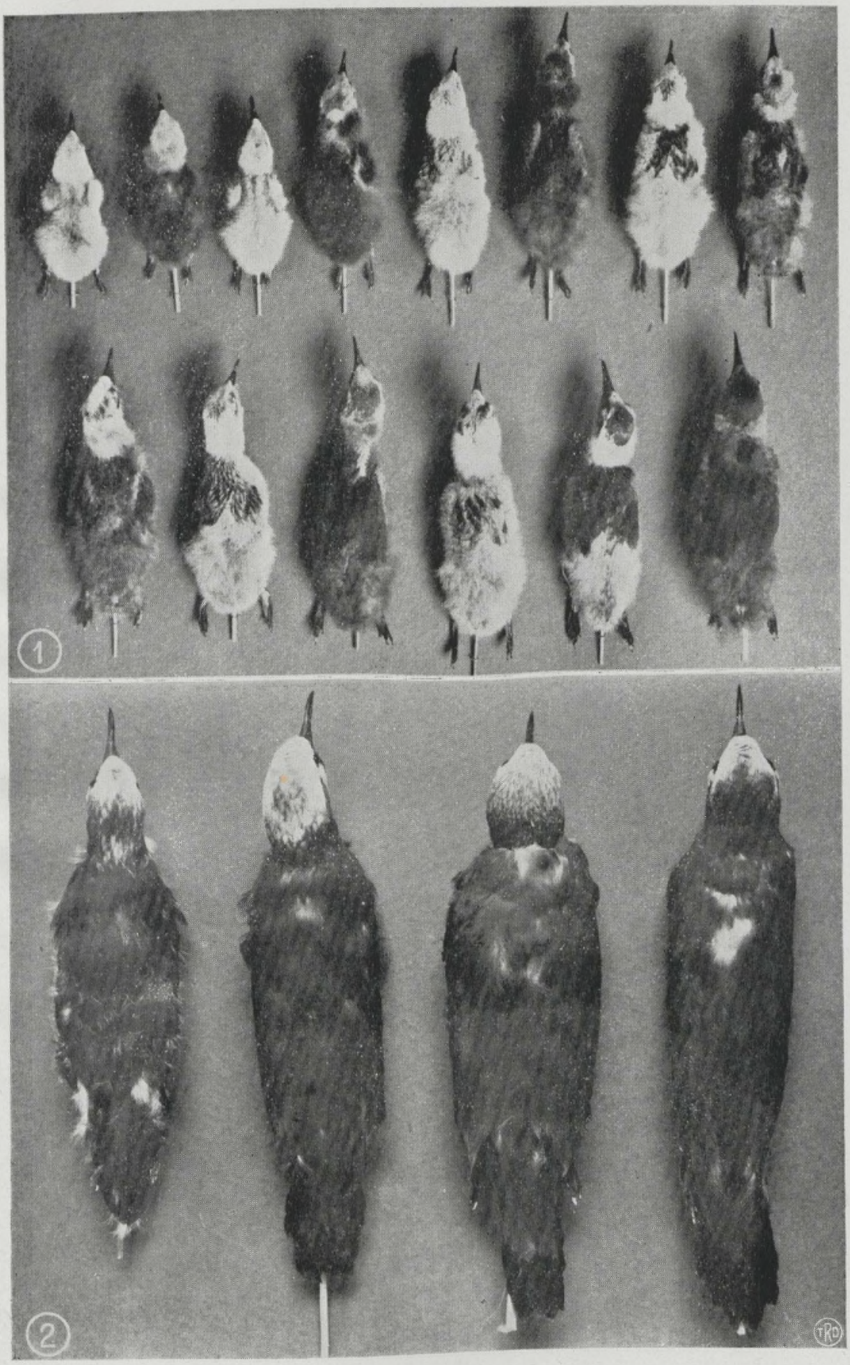
A. C. V. VAN BEMMEL & A. HOOGERWERF:
The Birds of Goenoeng Api.

Fig. 1. Twelve of the most divergent clutches of *Fregata m. minor*. — Fig. 2. Idem of *Anous stolidus pileatus*. — Fig. 3. Idem of *Sterna anaetheta anaetheta*.



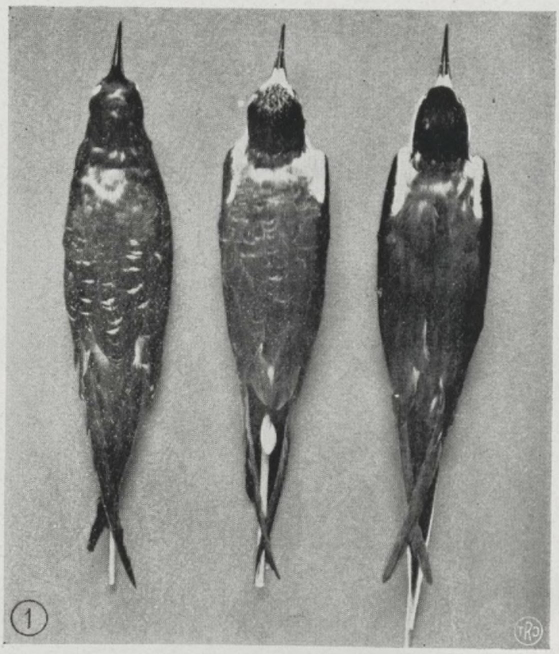
A. C. V. VAN BEMMEL & A. HOOGERWERF:
The Birds of Goenoeng Api.

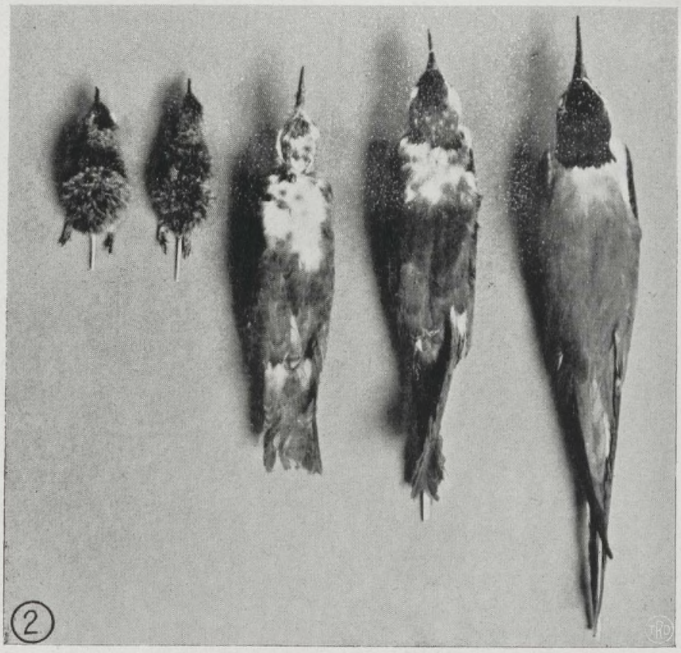
Fregata m. minor. — Fig. 1, left to right: Young of *ca* 7, 18, and 25 days, and two of 5 weeks. — Fig. 2 & 3, left to right: Young of *ca* 7, 9 and 12 weeks, one young of probably more than a year old, one adult ♀ and one adult ♂.



A. C. V. VAN BEMMEL & A. HOOGERWERF:
The Birds of Goenoeng Api.

Anous stolidus pileatus. — Fig. 1. Chicks in different phases of an age of 2 to 10 days. — Fig. 2, left to right: Young of about 3 and 4, and two of 5 weeks old.





A. C. V. VAN BEMMEL & A. HOOGERWERF:
The Birds of Goenoeng Api.

Sterna fuscata nubilosa. — Fig. 1, left to right: Full-fledged young, young in the transitional feathering, and adult bird. — Fig. 2, left to right: Chicks of about 3 or 4 days, young of 3 and 5 weeks, and one adult bird.

ESTIMATION OF CHLORIDES IN 1 C.C. SEA WATER SAMPLES BY MEANS OF SYRINGE PIPETTES.

By

L. VAN DAM

(Laboratorium voor het Onderzoek der Zee, Batavia).

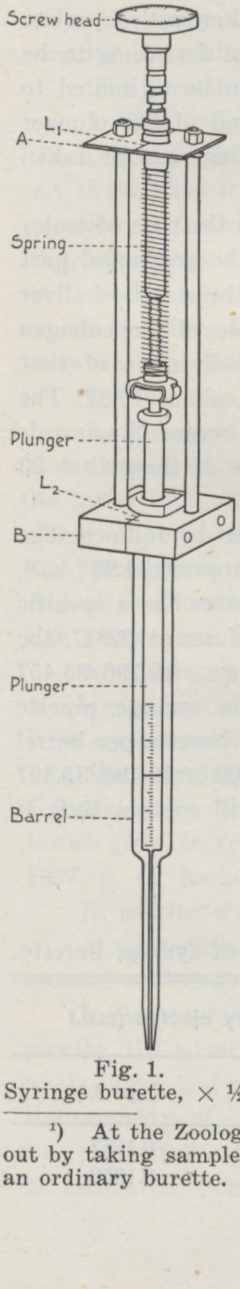


Fig. 1.
Syringe burette, × ½.

Rapid deliveries of small quantities of fluid can be made with a high degree of accuracy with syringe pipettes, as described by KROGH and KEYS (1931). In a somewhat modified form these pipettes are also in use now in the estimation of oxygen in about 1 c.c. of water (VAN DAM 1933, 1935, cf. also KROGH 1935 and FOX and WINGFIELD 1938), ensuring both the sampling and the addition of reagents to take place without coming into contact with air. TREVAN (1925) constructed a syringe pipette, the plunger of which was controlled by a micrometerhead, so that the syringe could also be used as a microburette. A similar microburette was employed by FOX and WINGFIELD (1938) in oxygen determination.

As far as is known syringe pipettes have not been used in chlorine titration [1]). Therefore, I carried out such titration, using a syringe pipette and a simple syringe burette.

The basis of the technique is the titration method of MOHR, which is generally used in Oceanography (cf. BEIN a.o. 1935).

The water sample (about 1 c.c.) is taken with a syringe pipette (VAN DAM 1935). The head of the plunger had been ground flat, making the surface of the head as near right angles to the axis of the plunger as possible. The lower end of the screw had been tapered, thus making the contact between the plunger and the screw small. As a result plunger rotations which may occur during manipulation have only little effect on the deliverance volume of the syringe.

The water sample is transferred into a small, white, porcelain dish (diam. 4 cm, height 1.5 cm) and is then titrated against silver nitrate solution. Since a TREVAN

[1]) At the Zoological Station, den Helder, Holland, chlorine titrations are carried out by taking samples with a syringe pipette and adding silver nitrate solution with an ordinary burette.

micrometer syringe (see above) was not available, the silver nitrate solution was added with the aid of a syringe pipette which was modified in a simple manner, in order to serve as a micro-burette.

This syringe burette is constructed as follows (fig. 1). The lower end of the barrel is calibrated. The distance between two adjacent graduations equals the speed of the screw. The screw is supplied with a fairly large head which has its circumference graduated into 50 divisions. To make readings at the head possible, the syringe is provided with a metal plate (A) on which a fine ink line is drawn (L_1). A white line (L_2), parallel with L_1, is painted on the vulcanite block B. Readings on the calibrated screw head are taken with L_1 when looking from the head downwards L_2 in such a position that L_2 seems to be covered by L_1 up to a fixed point (the cross line); they can be estimated to 0.002 of a barrel division. Thus the position of the lower end of the plunger can be roughly estimated on the barrel whereas precise readings can be taken at the head of the screw.

The capacity of the syringe burette was about 0.8 c.c. In the case of water with a chlorinity lower than 20 ‰, only the upper half of the graduated part of the barrel (about 20 divisions) was used in titration since the standard silver nitrate solution was made of such a strength that a sample of Copenhagen standard water required about the same number of barrel-divisions of that solution as its chlorine content in ‰ was stated to be, i.e. about 19.37. The weight of the amount of mercury ejected by turning the screw downwards from one position to another showed the deliverance volume of these first 20 barrel divisions to be practically constant (Table I).

The strength of the silver nitrate solution was calculated as follows. The Copenhagen standard water had a chlorinity of 19.368 ‰ = approx. 34.99 ‰ S. According to the graph of SCHUMACHER (1922, p. 305) this water has a specific gravity at 29° C (room temperature) of about 1.0221. Therefore, at 29° C, the water contains $1.0221 \times 19.368 = 19.796$ g. chlorine per litre $\equiv 19.796/35.457$ N sodium-chloride. Suppose the deliverance volume of the syringe pipette amounts to V c.c. and the deliverance volume of the syringe burette per barrel division to B c.c. Then the silver nitrate solution will be $V/1000 \times 19.796/35.457 \times 1000/19.368 \times 1/B$ N $= V/B \times 0.028826$ N. Hence it will contain $V/B \times 0.028826 \times 169.89$ g. silver nitrate per litre.

Table I.

Determination of deliverance volume per 10 barrel divisions of syringe burette.

Plunger moved from graduation	Volume of mercury ejected (c.c.)	
	Exp. 1.	Exp. 2.
0 — 10	0.1857	0.1857
10 — 20	0.1858	0.1858

It proved to be of advantage to add the indicator (one drop of a 4 % K_2CrO_4 solution) before adding the silver nitrate solution, because if it was added before the precipitate of silver chloride would turn more or less black and so would obscure the endpoint of the titration.

Only carefully cleaned pipettes, porcelain dishes and glass rods should be used. The water to be analysed, together with the solution of Copenhagen standard water (or sodium chloride) and silver nitrate, should be placed in a large dish, filled with water, to avoid temperature differences. Since variations in room temperature cause variations in the deliverance volume of the pipettes, it is necessary to determine α (cf. the Knudsen Hydrographical Tables) at regular intervals, e.g. every hour.

The procedure during actual analysis is as follows:

1. The syringe pipette is rinsed three times with the water to be analysed. Then the sample is drawn in and ejected into a porcelain dish. If more samples are to be taken from the same water the pipette need not be rinsed again. During ejection of the sample care is taken that the pointed cannula of the syringe dips approximately as far below the water surface as during the sampling (two or three mm), uniformity of manipulation being necessary to keep the deliverance volume of the syringe constant. The cannula of the syringe must not be cleaned between sampling and ejection.

2. One drop K_2CrO_4 solution is added.

3. The syringe burette is rinsed with silver nitrate solution and then filled. Some excess of solution is drawn in. Then the burette is clamped with one of its metal rods, in such a way that between its axis and the table there is an angle of about 45°. The screw is then turned so that both the lower end of the plunger and the head of the screw are adjusted to zero. Next the delivery end of the burette is cleaned by wiping with filter paper and then introduced one or two mm into the sample.

4. About ninety per cent. of the required amount of silver nitrate solution is added, after which the silver chloride precipitate is stirred for three minutes with a glass rod to release the chlorine that had been trapped in the precipitate into the solution (cf. BEIN a.o. 1935, p. 54). Then the titration is completed. I consider the endpoint to be reached when the titration fluid turns from yellowish green to yellowish brown and remains so if moderately stirred (cf. MEYER 1927, p. 41, footnote).

In routine work one analysis requires about 8 minutes.

A comparison between the above micromethod and the ordinary macromethod was made by analysing a series of samples of the same water (Table 2).

In the macromethod the sample was taken with an ordinary 15 c.c. Knudsen pipette, the silver nitrate solution was administered with a burette which had at its upper end a bulb with a capacity of about 16 units (1 unit = 2 c.c.) of the quantity of silver nitrate solution to be added. The stem of the burette was graduated, upwards from 16.00, into 0.05, so that 0.005 ‰ chlorine could be estimated. For this burette no volume correction table (cf. BEIN a.o. 1935,

Table 2.

Results obtained by micromethod and macromethod. The silver nitrate solution was standardized against a standard NaCl solution (sample no. 2) with a chlorinity of 19.368 ‰.

	No. of sample	Required amount of $AgNO_3$ solution	α	k	Cl ‰
Micromethod	1	19.224			
	1	19.224			
	1	19.224			
	1	19.226			
	2	19.370			
	2	19.370	-0.002		
	2	19.370			
	3	17.720			
	3	17.726		0.036	17.759
Macromethod	2	19.385			
	2	19.385	-0.017		
	2	19.385			
	3	17.750			
	3	17.755		0.023	17.775

p. 33) was available. In both methods α and k (cf. the Knudsen Hydrographical Tables) were obtained from graphical interpolation (cf. MÖLLER 1933, Fig. 2).

It will be seen that in the micromethod a relative accuracy of about 0.005 g. chlorine per litre was obtained.

If many titrations must be carried out the above method is relatively inexpensive since the required amount of silver nitrate is about one fifteenth of that used in the ordinary macromethod. Furthermore, it may be used with advantage in the field and on board ship since the apparatus is easily portable and no more liable to breakage than are ordinary pipettes and burettes.

Summary.

With the aid of syringe pipettes chlorine analyses are carried out on 1 c.c. samples of sea water, on basis of the MOHR procedure. With adequate lighting a relative accuracy of about 0.005 g. chlorine per litre is obtained.

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THE MAMMALS OF THE NETHERLANDS INDIAN MT. LEUSER EXPEDITION 1937 TO NORTH SUMATRA.

By

F. N. CHASEN

(Director, Raffles Museum, Singapore).

The specimens on which this report is based were collected by Mr. A. HOOGERWERF during the period 16th January—16th May, 1937. They are the property of the Zoological Museum, Buitenzorg, to the Director of which institution I am grateful for the opportunity of studying the material.

The forested mountains of Leuser (3466 m) and Lemboe (3044 m) were the main objectives, but the majority of the skins came from the primary forest, and secondary growth of the approaches and neighbouring country. Mr. HOOGERWERF will describe and illustrate the country and his journey in detail in our forthcoming paper on the birds of the expedition. Prior to Mr. HOOGERWERF's visit the area was unknown zoologically and his collections give us the first insight into the mammal fauna of the mountains of North-West Sumatra. In view of the recent publication of "A Handlist of Malaysian Mammals" I have not thought it necessary to repeat synonymies, or regional literature.

The most striking result is the discovery of a new rat, *Rattus hoogerwerfi*, which for the present we must regard as a full species, for it seems to have no close relatives.

New forms described are *Rattus bukit lieftincki* and *Sciurus notatus percommodus;* and additions to the Sumatran fauna are *Rattus rajah pellax* and *Hipposideros sabanus,* the former a Malayan and the latter a Bornean form.

Tupaia glis jacki ROB. & KLOSS.

Tupaia glis jacki ROBINSON and KLOSS, Journ. Fed. Mal. States Mus., VIII, pt. 2, 1918, p. 15: Siolak Daras, Kerintji Valley, West Sumatra.

1 ♂, 1 ♀ Atang Poetar, 1.000 m; 1 ♀ Poelau Moenteh (near Pendeng), 550 - 750 m.

Tupaia tana tana RAFF.

Tupaia tana RAFFLES, Trans. Linn. Soc., XIII, 1821, p. 257: west coast of Sumatra, probably Benkoelen.

1 ♂ imm. Lesten 700 m; 1 ♂ Simpang Agoesan, 1.000 m.

The adult matches specimens from Benkoelen.

Tupaia javanica occidentalis ROB. & KLOSS.

Tupaia javanica occidentalis ROBINSON and KLOSS, Journ. Fed. Malay States Mus., VIII, pt. 2, 1918, p. 16: Soengai Penoh, Kerintji Valley, West Sumatra.

1 ♂ Kotatjane, 200 m; 1 ♂ Palok, 800 - 1.000 m; 1 ♀ Atang Poetar, 1.000 m; 1 ♂, 1 ♀ Poelau Moenteh (near Pendeng), 550 - 750 m.

Measurements of *Tupaia* spp. from Sumatra.

Name	Sex	Head and Body	Tail	Hind-foot	Skull							No.	Remarks
					Greatest length	Basal length	Palatal length	Upper molar row (alveoli)	Tip of pre-maxillaries to lachrymal notch	Interor-bital breadth	Greatest breadth		
Tupaia glis jacki	♀	182	180	42	50	43.6	27.3	15.5	22.3	14.5	26	348	Adult
„	♀	178	164	44	50.9	43.2	26.7	15.5	22	14.5	25 5	463	„
Tupaia tana tana	♂	220	170	46	61.5	53	34.7	17.2	30.5	15.2	26.9	506	„
Tupaia javanica occidentalis	♂	139	171	36	41	36.2	21	—	15.6	12	22.2	493	„
„	♂	143	165	35	41.2	35.6	21.6	12.2	15.9	12.7	21.6	339	„
„	♀	137	167	35	41.3	36	—	12	15.5	12.4	21.5	361	„

Crocidura aequicauda ROB. & KLOSS.

Crocidura aequicauda ROB. & KLOSS, Journ. Fed. Malay States Mus., VIII, pt. 2, 1918, p. 22: Soengai Kring, Kerintji Peak, West Sumatra, 7.200 ft.

1 ♀ Mt. Leuser, ca 3.400 m, 5.12.1937.

The collector's measurements taken in the field are.— head and body, 73; tail, 60; hind-foot, 13 mm, but judging from the skin I think I should have obtained rather higher figures for both tail and hind-foot.

Skull. — Total length including teeth, 20.3; greatest breadth, 9.3; front side of anterior tooth to back of last molar, 9.1; alveolar length of entire tooth-row, 8; greatest ante-orbital breadth, 6; length of entire mandibular tooth-row from point of anterior tooth to back of last molar, 8.3 mm.

This identification cannot be regarded as absolutely certain, for the type of *aequicauda* is now in London.

Galeopterus variegatus temminckii (WATERH.).

Galeopithecus temminckii WATERHOUSE, Proc. Zool. Soc. 1838, p. 119: Sumatra.

1 ad. ♂, 1 ad. ♀ Poelau Moenteh (near Pendeng), 550 - 750 m.

As is normal in the Sumatran race of *Galeopterus* these skins of opposite sexes are much alike in colour: the female is merely slightly paler grey, and rather more washed with buff on the upper parts than the male.

Collector's external measurements. — Head and body, 378, 414; tail, 280, 260; ear, 21, 23; hind-foot, 77, 72 mm.

Skull. — Greatest length, 73.3, 74.8; condylo-basal length, 69, 71.5; basal length, 64.4, 66.5; greatest breadth, 47.7, 49 mm.

Cynopterus horsfieldi lyoni AND.

Cynopterus horsfieldi lyoni ANDERSEN, Cat. Chir. Brit. Mus., 1912, p. 827: *nom. nov.* for *Niadias minor* LYON, 1908 (not *C. minor* TROUESS. 1878): Siak River, East Sumatra.

1 ♂ Poelau Moenteh (near Pendeng), 550 - 750 m.

Forearm, in the skin, about 73 mm. *Skull.* — Total length, 35; zygomatic breadth, 24.5 mm.

Rhinolophus acuminatus sumatranus AND.

Rhinolophus sumatranus ANDERSEN, Proc. Zool. Soc., 1905, p. 133: Lower Langkat, Sumatra.

1 ♂ Lesten, 700 m.

Forearm, 46.5 mm.

Hipposideros sabanus THOS.

Hipposideros sabanus THOMAS, Ann. Mag. Nat. Hist. (7), I, 1898, p. 243: Sarawak.

1 ♀ Atang Poetar, 1.000 m.

Forearm, 39.5 mm. This bat has the terminal part of the nose-leaf entire and not divided into cells. There is no small upper premolar, and the corresponding lower tooth is extremely small. The specimen agrees well with the

description of *sabanus*, but no specimens of the latter are available for comparison. The species has not hitherto been recorded from Sumatra.

Myotis muricola muricola (HODGS.).

Vespertilio muricola HODGSON, in GRAY, Cat. Mamm. Nepal etc. 1846, p. 4: Nepal.

1 ♂ Simpang Agoesan, 1.000 m.

Forearm, 36.5 mm.

Nyctalus stenopterus (DOBS.).

Vesperugo stenopterus DOBSON, Proc. Zool. Soc., 1873, p. 470: Sarawak.

1 ♂ Kampoeng Bada.

Forearm, 43 mm.

Kerivoula hardwickii hardwickii (HORSF.).

Vespertilio hardwickii HORSFIELD, Zool. Researches, Java, 1824: Java.

1 ♀ Kampoeng Bada.

Forearm, 36.5 mm.

Simia satyrus abelii (LESS.).

Pongo abelii LESSON, Man. Mamm., 1827, p. 32: Sumatra.

1 imm. (dentition incomplete) ♂, 1 ad. ♀ Poelau Moenteh (near Pendeng), 550 - 750 m.

The great toes are without nails. My comparative material is limited to a good series of skins exported from Borneo, and said mostly to be from the Pontianak area. The Sumatran skins are more uniformly coloured, and are of a slightly paler "chestnut" colour: they lack the conspicuously darker maroon element in the pelage. In both specimens the hair on the crown is of the same cinnamon-rufous colour as that on the back, whereas in the Bornean series the crown is always among the darker areas of colour. There is no coronal crest in the adult.

Collector's external measurements. — Head and body, 770, 950; ear, 36, 30; hind-foot, 228, 293 mm. *Skulls.* — Basal length, 122, 138.5; zygomatic breadth, 113, 118; mastoid breadth, 113, 111; upper tooth row including canine (alveoli), —, 64.5 mm.

Hylobates syndactylus syndactylus (RAFF.).

Simia syndactyla RAFFLES, Trans. Linn. Soc., XIII, 1821, p. 241: Benkoelen, West *Sumatra*.

1 ♂, 1 ♀ Poelau Moenteh (near Pendeng), 550 - 750 m; 1 ♂ Blang Kedjeren, 800 m; 1 ♂ Lesten-Pendeng, 550 - 700 m.

In these skins the pelage is slightly shorter and thinner than in others from higher levels on Mt. Kerintji. As usual the largest skull in each sex slightly exceeds the maximum size of the continental siamang. The skulls are characteristic of the Sumatran race. The largest male (No. 363) has four upper molars. it is, therefore, measured from the back of the third molar. For measurements see page 484.

Hylobates lar albimanus (VIG. & HORSF.).

Simia albimana VIGORS and HORSFIELD, Zool. Journ., IV, 1828, p. 107: Benkoelen, west coast of Sumatra.

Hylobates albimanus LYON, Proc. U.S. Nat. Mus., XXXIV, 1908, p. 673; Aroe Bay, N. E. Sumatra.

1 ♂, 1 ♀ Poelau Moenteh (near Pendeng), 550 - 750 m; 1 ♂, 1 ♀ Atang Poetar, 1.000 m; 1 ♂ Simpang Agoesan, 1.000 m.

Simia albimana was based on two specimens of the white-handed gibbon brought from Sumatra by RAFFLES. According to the description one was black with a complete white facial ring; the other was "light brownish grey" in general colour.

The general colour of all the present specimens is brown. They all have an ill-defined, slightly darker cap; the posterior half of the upper parts much paler than the anterior half; and a complete broad, white facial ring. Nevertheless, the skins vary much in tone and details of colour pattern, and no two are alike. The amount of white on the hands and feet is especially variable. In one case the brown of the forearm extends, broadly, onto to the back of the hand; in another, the forearm is quite white an inch above the wrist.

Judging by the published description, LYON's series of skins from Aroe Bay in North-East Sumatra is very like the present one; and a specimen collected by MADZOED at Aloer Poerba, North Atjeh in 1930 also matches reasonably well. Unless the luck of collecting has been very uneven it seems, therefore, that black, and cream-coloured animals are rare, or non-existant in North Sumatra. The position in the remainder of the island is not clear owing to lack of material and records.

As represented by these northern specimens *albimanus* and typical *lar* of the Malay States are separable on colour. In the south, the latter is usually black, or fairly uniformly dark brown; in the north, cream-coloured animals predominate, but from no part of the Peninsula have I seen specimens showing the combination of peculiar brown colour, dark cap, and particoloured back of *albimanus,* although one or two brown skins from the extreme south of the Malay States provide links between the two forms.

Wherever they occur much above sea-level, gibbons of all the Malaysian forms have the pelage thicker and longer than their neighbours at lower levels. All the present specimens show this character, but it is most marked in the female from Atang Poetar in which the fur on the back has an average length of about 80 mm and can be pulled to 100 mm.!

LYON (*l.c.s.*) gives certain cranial and dental characters by which his material of *albimanus* and *lar* can be separated. In an examination of all available specimens, including many *lar* from the Malay Peninsula, I find that although the distinctions are not absolute, all those quoted for *albimanus* being adumbrated in a minority of *lar,* the extremes are always quite distinct. A *series* of skulls could be referred to a subspecies without difficulty. For measurements see page 484.

Measurements of *Hylobates* spp. from North-West Sumatra.

Locality	Sex	Head and Body	Hind-foot	Skull				No.	Remarks
				Greatest length	Basal length	Zygomatic breadth	Maxillary tooth-row with canine (alveoli)		
H. lar albimanus.									
Pendeng, 550—750 m.	♂	445	116	98	67.3	66.8	30	395	Adult
„	♀	488	147	101.5	71.3	—	28.2	366	„
Atang Poetar, 1,000 m.	♂	415	125	—	—	—	—	480	Immature
„	♀	456	135	98	71.5	66	27.2	481	Adult
Simpang Agoesan, 1,000 m.	♂	470	153	104	72.5	64.5	30.5	503	„
H. s. syndactylus.									
Pendeng, 550—750 m.	♂	590	174	129	97.7	88.5	39.5	363	„
„	♀	575	157	124.5	94.5	85	[42,3	362	„
Blang Kedjeren, 800 m.	♂	465	142	—	—	—	—	309	Immature
Lesten-Pendeng 550—700 m.	♂	591	159	121	93.5	76.8	39.8	419	Adult

A note on Malaysian gibbons. — The oft repeated dictum that the skulls of *agilis* and *lar* are alike needs correction. Excluding certain average distinctions that fail only in a minority of specimens to separate the two forms (e.g., the less elliptical foramen magnum of *lar*), I find that *agilis* always has more projecting supraorbital ridges (in the lateral view, the apex higher; in the dorsal view, the post-orbital depression deeper), with the corollary of more rounded, less flattened and usually narrower dorsal orbital rims.

Comparing skulls of Malayan and Sumatra *agilis* I find that, as in *lar*, there is a tendency to straighter nasals (profile) in the island series, but the distinction is less decided than in *lar*, and two out of eight Sumatran skulls are well-marked exceptions.

Turning to colour, I have not yet seen a Malayan *agilis* so uniformly black on the upper parts as are some from Sumatra: Malayan skins in the dark phase are blackish brown on the lower back, but the difference between specimens from the two localities is not well marked, and the series examined are small. In the Malay States *agilis* is not common, and much less numerous than *lar*: in most parts of Sumatra the situation is reversed.

Macaca nemestrina nemestrina (LINN.).

Simia nemestrina **LINN., Syst. Nat., 12th. ed., I, 1766, p. 35: Sumatra.**

1 ♂ imm. Poelau Moenteh (near Pendeng), 550 - 750 m.

Collector's external measurements. — Head and body, 571; tail, 182; ear, 39; hind-foot, 162 mm.

The *skull* measures 94.1 mm in basal length, and 84.5 mm in zygomatic breadth. The back molars are not fully grown.

Macaca irus irus F. CUV.

Macacus irus **F. CUVIER, Mémoires du Mus. d'Hist. Nat. Paris, IV, 1818, p. 120: Sumatra.**

1 ♂ Mt. Setan-Meloewak, 325 - 520 m; 1 ♂ Lesten, 700 m.

The largest specimen measured, in the flesh, head and body, 451; tail, 622; ear, 36; hind-foot, 138 mm. The *skull* with a strong crest and worn teeth measures. — Total length, 124; basal length, about 89; zygomatic breadth, 80.5; maxillary tooth row including canine (alveoli), 38 mm. The second skull is of a younger animal; the dentition is complete but the teeth are scarcely worn and there is no crest on the cranium. — Basal length, 83.4; zygomatic breadth, 78; maxillary tooth row, 36.5 mm.

Pithecus pyrrhus cristatus (RAFFLES).

Simia cristatus RAFFLES, Trans. Linn. Soc., XIII, 1821, p. 244: Benkoelen, West Sumatra.

1 ♂, 1 ♀ Kotatjane, 200 m.

These specimens are not quite so dark as most skins from South Sumatra, and they must be regarded as diverging towards the paler, more silvered race

Measurements of *Pithecus* spp. from N.W. Sumatra.

Locality	Sex	Head and Body	Tail	Hind-foot	Skull				Collector's No.	Remarks
					Greatest length	Basal length	Zygomatic breadth	Maxillary tooth-row with canices (alveoli)		
Pithecus pyrrhus cristatus.										
Kotatjane, 200 m. . . .	♂	503	782	169	102	75	78.9	31.6	491	Adult
,, ...	♀	528	738	169	95.5	68.7	73	30	492	,,
Pithecus aygula thomasi.										
Lesten, 700 m.	♂	479	825	172	97	62	70.4	29	407	Adult
,, ...	♂	473	662	177	92	58.8	66.6	27.7	411	Subadult
,, ...	♂	521	723	175	98.5	61	75.5	30	396	Adult

found in the Malay States, *P. p. ultimus,* to which form examples of this species from the lowlands of North-East Sumatra can be definitely referred. For measurements see page 486.

Pithecus aygula thomasi (COLL.).

Semnopithecus thomasi COLLETT, Proc. Zool. Soc., 1892, p. 613, pl. XLII: Langkat, North-East Sumatra.

3 ♂ Lesten, 700 m.

No really satisfactory comparative material is available in Singapore. A specimen from Aroe Bay on the north-east coast of the island is paler than the Leuser skins, but it was collected in 1905, and has since been exposed to light. For measurements see page 486.

Nycticebus coucang coucang (BODD.).

Tardigradus coucang BODDAERT, Elench. Anim., 1785, p. 67: probably Malacca.

1 ad. ♀ Meloewak-Koengke, 520 - 825 m.

This specimen differs from examples of *coucang* from the Malay States and North-East Sumatra only in the rather more richly coloured upper parts which, except for the greyer limbs, match those of *borneanus.* The skull has two pairs of upper incisors. The least distance between the crests of the temporal ridges is about 4 mm. The colour difference may indicate a montane race for which the name *hilleri* (STONE and REHN, Proc. Acad. Sci. Philad., 1902, p. 139: Padang Highlands) is available, but the present specimen does not show the large size and wrinkled bullae postulated for that form by LYON (Proc. U.S. Nat. Mus., XXI, 1906, p. 534).

Collector's external measurements. — Head and body, 294; tail, 21; ear, 18; hind-foot, 61 mm. *Skull.* — Greatest length, 59.1, basal length, 49.6; greatest width, 41.6; front of canine to back of last molar, 20.5 mm.

Lutra sp.

1 juv. ♀ Blang Kedjeren, 800 m.

A kitten, I think of *L. l. barang* CUV.

Paguma larvata leucomystax (GRAY).

Paradoxurus leucomystax J. E. GRAY, Proc. Zool. Soc. IV, 1837, p. 88: Sumatra.

1 ad. ♂ Poelau Moenteh (near Pendeng), 550 - 750 m.

A typical example of the Sumatran subspecies.

Collector's external measurements. — Head and body, 757; tail, 578; ear, 43; hind-foot, 115 mm.

Skull. — Greatest length, 132; condylo-basal length, 129; basal length, 124; palatal length, 63.5; greatest diameter of pm^4, 10.8; mastoid breadth, 48; zygomatic breadth, 69.4 mm.

Felis temminckii temminckii VIG. & HORSF.

Felis temminckii VIGORS and HORSFIELD, Zool. Journ., III, 1827, p. 451: Sumatra.

1 young ad. ♂ Blang Kedjeren, 800 m.

Collector's external measurements. — Head and body, 632; tail, 395; hind-

foot, 154; ear, 46 mm. *Skull.* — Greatest length, 111; basal length, 95; condylo-basilar length, 89; zygomatic width, 73; mastoid width, 46.5; upper carnassial, 15 by 6.8 mm.

A skin in the reddish brown phase, greyest on the feet and brightest on the nape and spine. According to the scanty published record and the few available specimens, continental specimens of this cat run larger than do exact topotypes, but the latter are rare in collection, and our knowledge of the species is still very incomplete.

Manis javanica DESM.

Manis javanica A. G. DESMAREST, Ency. Méth. (Mamm.), II, 1822, p. 377: Java.

1 juv. ♂ Blang Kedjeren, 800 m.

A very young animal with a total length of 644 mm. The distal one-third of the tail is whitish.

Longitudinal rows of scales round the body, 17; total number of scales in the longitudinal line, 62; number of scales in the upper median line of tail only, 29.

Petaurista petaurista batuanus MILL.

Petaurista batuana MILLER, Smiths. Misc. Coll., 45, 1903, p. 27: Batu Islands, West Sumatra.

3 ♂ Atang Poetar, 1.000 m; 1 ♂ Lesten, 700 m.

In colour the Sumatran race is intermediate between the dark Javan forms and the very much paler and redder *melanotus* of the Malay Peninsula, but it is quite distinct. For measurements see page 493.

Aeromys tephromelas bartelsi (SODY).

Petaurista bartelsi SODY, Natuurk. Tijdschr., XCVI, 1936, 146: Pematang Siantar, Deli District, North-East Sumatra.

1 ♀ Poelau Moenteh (near Pendeng), 550 - 750 m.

This race is very close to the typical form from the Malay Peninsula. At the moment I cannot see how *bartelsi* differs unless it is by reason of its less grizzled under parts, but the available material of *tephromelas* is poor, and I have only two specimens from Sumatra for comparison. For measurements see page 493.

Ratufa bicolor palliata MILL.

Ratufa palliata MILLER, Proc. Acad. Nat. Sci. Philad., 1902, p. 147: Indragiri River, East Sumatra.

1 ♂ Poelau Moenteh (near Pendeng), ± 750 m.

The available comparative material is from Kerintji and North-East Sumatra: it confirms that the colour in any one place is very variable. The present skin is unique among the Sumatran series in that the black nape is fairly sharply defined against the cream-brown back, but judging from the original description a similar phase occurs in the type locality of *palliata*. The

details of the skull are as in *palliata* and not as in the neighbouring *laenata* of the Banjak Islands. For measurements see page 493.

Sciurus prevostii piceus PETERS.

Sciurus piceus PETERS, Proc. Zool. Soc., 1866, p. 428: Tenasserim, error for North Sumatra.

3 ♂, 2 ♀ Lesten, 700 m.

These specimens are like others from Aroe Bay, and other places further south, in North-East Sumatra. The action of alcohol on the skins is to change the colour of the under parts to a much deeper, darker red. For measurements see page 493.

Sciurus notatus tapanulius LYON.

Sciurus vittatus tapanulius LYON, Smiths. Misc. Coll., XLVIII, 1907, p. 280: Tapanoeli Bay, West Sumatra.

2 ♀ Kotatjane, 200 m.

These two specimens are clearly referable to *tapanulius* with which they have been compared. The under parts are deeply coloured, rufous to ferruginous rather than near ochraceous or orange-rufous; the feet are concolorous with the back; and the dark lateral stripe is finely grizzled with rufous. For measurements see page 494.

Sciurus notatus percommodus subsp. nov.

Sciurus vittatus albescens LYON, *nec* BONHOTE, Smiths. Misc. Coll., XLVIII, 1907, p. 281.

4 ♂, 6 ♀ Lesten, 700 m.

Compared with *S. n. tapanulius* darker and less ochraceous on the upper parts; the feet usually tinged with orange; the under parts less tawny-ferruginous, and tending to a paler pink or orange. Coloured under parts copiously mixed with white hairs, and the dark lateral stripe heavily overlaid with white tips to the hairs.

Type. — Adult female (skin and skull), collected at Lesten, Atjeh, North Sumatra, on 21st March, 1937 by A. HOOGERWERF. Buit. Mus. No. 416. For measurements see the table on page 494.

Remarks. — This form seems to replace *tapanulius* in the submontane country north of Kotatjane. Judging from LYON's description its range extends to the northern point of Sumatra at Loh Sidoh Bay, and to Aroe Bay on the North-East coast. In the low country of the east coast, south of Aroe Bay the next race is *nicotianae* which is described as having the under parts strongly ochraceous, and the dark lateral stripe grizzled with the same colour.

Sciurus nigrovittatus bocki ROB. & WROUGHT.

Sciurus nigrovittatus bocki ROBINSON and WROUGHTON, Journ. Fed. Malay States Mus., IV, 1911, p. 167: Padang Highlands, Sumatra.

1 ♀ Poelau Moenteh (near Pendeng), 550 - 750 m; 4 ♂, 4 ♀ Atang Poetar, 1.000 m.

The skins exactly match others from Kerintji, excepting that the specimen from the lowest altitude, Pendeng (No 343) has the largest skull of any example of *bocki* yet recorded. Even admitting that the smaller skulls are not aged the range of size (from 44.4 to 47 mm in greatest length) seems very large for one race in this genus, but the intergradation is complete and there are as yet no grounds for separating another form. For measurements see page 494.

Sciurus albescens albescens BONH.

Sciurus notatus albescens **BONHOTE, Ann. Mag. Nat. Hist. (7), VII, 1901, p. 446: Atjeh, North Sumatra.**

1 ♂ Meloewak-Koengke, 520 - 825 m; 1 ♂ Reket-Atang Poetar, 900 - 1.000 m; 1 ♂, 2 ♀ Atang Poetar, 1.000 m.

I have not examined the type of *albescens*, but the published measurements indicate that it represents this small species and not a local race of the larger *notatus*.

S. a. albescens and *S. notatus percommodus* are much alike in colour and in both forms the dark lateral stripe is overlaid with white hairs, but *albescens* is duller on the under parts than *percommodus* and the dark lateral stripe tends to be wider.

Some comments on *S. albescens* were offered in my "Handlist of Malaysian Mammals", p. 140. It seems to be a submontane species, at least largely replacing the *S. notatus* forms at moderate altitudes, but we know that as *S. albescens adamsi* it infiltrates into the lowlands in North Borneo. When submontane it has always been found in close proximity to a form of *S. nigrovittatus*, although the latter usually seems based on a slightly higher level. Excluding colour the difference between the parallel *albescens* and *nigrovittatus* subspecies is very slight, but existing material does indicate that in Sumatra, *S. a. albescens* runs very slightly shorter in the skull than *S. n. bocki;* and that in North Borneo, *S. a. adamsi* is very slightly broader in the skull than *S. n. venustus*. Topotypical *S. albescens adamsi* from Sarawak is known from very poor material only, and it will be interesting to know whether or not a northern race is separable from it on slightly larger size, as is *S. n. venustus* from *S. n. orestes*. For measurements see page 494.

Sciurus tenuis surdus MILL.

Sciurus tenuis surdus **MILLER, Proc. Wash. Acad. Sci., II, 1900, p. 80: Trang, Peninsular Siam.**

9 ♂, 3 ♀ Poelau Moenteh (near Pendeng), 550 - 750 m; 6 ♂, 3 ♀ Lesten, 700 m; 1 ♀ Ngo Lemboe, "bivak I" (23rd Febr.), 800 - 2000 m.

Mr. HOOGERWERF obtained this form at low levels. Specimens from other localities in the Sumatran lowlands, whence I have no material, have been referred to typical *tenuis* by several authors, but the present examples are paler in general colour than topotypes of *S. t. tenuis*. In a few of the skins the ochraceous areas on the shoulders are rather more extensive than in topotypical *surdus*, but otherwise the Sumatran series seems exactly like an even number

from the lowlands of the northern part of the Malay Peninsula. For measurements see page 495.

Sciurus tenuis altitudinis ROB. & KL.

Sciurus tenuis altitudinis ROBINSON and KLOSS, Journ. Strs. Br. Roy. Asiat. Soc., No. 73, 1916, p. 269: Kerintji Peak, Sumatra, 7.300 ft.

1 ♂ Palok, 800 - 1.000 m; 1 ♂, Simpang Agoesan, 1.000 m; 2 ♂, 3 ♀ Atang Poetar, 1.000 m; 1 Ngo Lemboe, "bivak I" (22nd Febr.), 800 - 2000 m.

According to the collector's data this form replaces *surdus* at higher levels although both forms were obtained from "bivak I" on Ngo Lemboe. Compared with the specimens listed above as *surdus,* the present subspecies is slightly larger; the rostrum is longer and narrower; the bullae are smaller; the pelage is thicker; the upper parts are darker; the pale spots on the sides of the muzzle are less conspicuous; and seen from above, as a series, the pale tips to the tail hairs are more buffy and less white. Although here put under *altitudinis* these specimens show some deviation in the direction of *S. t. gunong* from the mountains of Peninsular Siam in that the pelage is less thick, and the rostrum less consistently narrowed than in topotypical *altitudinis* which came from a higher altitude than the present series. But *gunong* always has the pale tips to the tail hairs bright rufous-buff.

It is noticeable that the skins from Atjeh are much whiter and less buffy on the under parts than those of the original series from Kerintji, but I am inclined to think that this difference is not a natural one and that possibly it is caused by different methods of preparation. For measurements see page 495.

Sciurus modestus modestus MÜLL.

Sciurus modestus S. MÜLLER, in TEMM., Verh. nat. ges. Ned. overz. bezitt., Zool., 1839, pp. 34, 55: Mt. Singgalang, Padang Highlands, Sumatra.

Tomeutes tenuis modestus, ROB. and KLOSS, Journ. F.M.S. Mus., VIII, pt. 2, 1918, p. 33 (Kerintji Valley, 2.450 ft); *id.,* VII, 1919, p. 272 (West Sumatra); *id.,* p. 310 (West Sumatra).

1 ♀ Poelau Moenteh (near Pendeng), 550 - 750 m; 1 ♀ Meloewak-Koengke, 520 - 825 m; 1 ♂ Palok, 800 - 1.000 m.

The material representing this form is poor and two of the skins have been in alcohol which almost invariably slightly alters the colour of squirrels. Nevertheless, the three skins together with the collector's data show that the submontane *modestus* in altitude partly overlaps the ranges of both *surdus* and *altitudinis.* General appearance suggests that *altitudinis* (represented in the Malay Peninsula by *gunong*), rather than *modestus* is the high level representative of *tenuis.*

In colour *modestus* is very near to both *surdus* and *altitudinus,* but it differs from both in the much deeper orange-buff colour of the anal region and under side of the tail: it is also rather greyer on the under parts. It leans to *surdus* in the pale, cold tone of the upper parts, and pure white tips to the tail hairs. In size it is larger than *surdus* and nearer to *altitudinis,* but it averages slightly

longer in the tail than this latter form. Series of measurements of *modestus* have been published by ROBINSON & KLOSS in the references quoted above.

The skull of *modestus* is large, like that of *altitudinis*, but seen from above the rostrum appears shorter and broader, as in *surdus*. The interorbital region tends to be broader than in *altitudinis* and the zygomata are often heavier. The bullae are relatively small, as in *altitudinis*.

In view of the overlap in range it is now necessary to separate *modestus* from the *tenuis* formenkreise and the following arrangement seems apposite.—

S. m. modestus, Sumatra; *S. m. tahan*, Malay States; *S. m. brookei*, Borneo.

Each of these three forms differs from its neighbouring *tenuis* form by reason of the brighter vent region and under side of the tail; larger size; and more robust skull. Whether or not the name *modestus* really applies to a member of this group only a fresh examination of the original series in Leiden can decide for the published descriptions and figures of *modestus* are too generalised to decide the point. In the meantime the view put forward by ROBINSON & KLOSS in 1913 is here accepted. For measurements see page 495.

Sciurus hippurus hippurosus LYON.

Sciurus hippurosus LYON, Smiths. Misc. Coll., L., 1907, p. 26: Taroesan Bay, West Sumatra.

1 ♀ Lesten, 700 m.

This skin is like specimens of *hippurus* from the Malay States in size and in the colour of the under parts but it differs in being darker, more tawny, on the upper parts. In the skull the dorsal portion of the premaxilla is narrower, and the zygomatic arch is more slender than in *hippurus*. The two small upper premolars are present. The character of the zygomatic arch alone is enough to separate the two subspecies. For measurements see page 493.

Funambulus insignis niobe (THOS.).

Funambulus niobe THOMAS, Ann. Mag. Nat. Hist. (7), II, 1898, p. 249: Padang Highlands.

3 ♂ (1 juv.), Atang Poetar, 1.000 m.

Collector's external measurements. — Head and body, 173, 176; tail, 90 imp., 103; hind-foot, 45, 44; ear, 20, 19 mm.

Skull. — Greatest length, 47.9, 48; condylo-basilar length, 39.3, 39.9; palatilar length, 20.5, 21.3; diastema 12, 12.5; upper molar row, 8.7, 8.5; greatest length of a nasal, 14.9, 14.7; zygomatic breadth, 26.2 mm.

Skins of *niobe* from Mts. Dempo and Kerintji near the west coast of Sumatra resemble the type of the subspecies in that the under parts from chin to tail are yellowish buff, the base of the fur being grey. From Mt. Ophir, ROBINSON & KLOSS have recorded a specimen with a large white patch on the forebreast, and the three skins from Atjeh also have more white on the under parts than a series of *niobe* from Kerintji. All three have the throat whitish, and in one specimen the middle line of the underparts is broadly white. These whiter animals are further distinguished by rather small skulls and it therefore

Measurements of *Sciuridae* from North-West Sumatra.

Species	Sex	Head and Body	Tail	Ear	Hind-foot	Skull: Greatest length	Skull: Condylo-basilar length	Skull: Palatilar length	Skull: Diastema	Skull: Upper molar row	Skull: Median nasal length	Skull: Inter-orbital breadth	Skull: Zygomatic breadth	No.	Remarks
Petaurista p. batuanus	♂	414	484	40	75	68.8	61	31.5	15.1	15.8	20.4	14.4	46.6	462	Adult
,,	♂	414	497	42	76	69.5	—	—	—	15.9	21.5	—	48.1	461	,,
,,	♂	429	439	44	76	69.4	60.5	32.4	15.1	17	21.6	13.5	48.4	428	,,
,,	♂	399	476	42	76	66.7	60	30.8	13.5	16.6	19.4	12.8	46	382	,,
Aeromys teph. bartelsi	♀	383	425	37	70	—	58.2	28.2	14.9	12	18.5	13	—	333	,,
Sciurus prev. piceus	♂	222	242	20	55	55.1	47.5	23.1	12.7	11	16.4	22.5	34.5	381	,,
,,	♂	239	242	20	57	55.1	47.8	23	12.5	10.5	17	21.5	34.1	408	,,
,,	♂	235	236	20	56	57.5	49.2	24.5	13.8	—	17.4	23.5	36	389	,,
,,	♀	217	219	19	54	54.3	47.2	23	12.6	11.5	16.9	21.6	33.7	417	,,
,,	♀	220	224	18	46	55.5	47.7	23.5	12.8	11.6	17.6	21	33.5	371	,,
Ratufa bicolor palliata	♂	371	458	34	83	73.3	62	27.5	16.5	14.4	23.5	30.5	46.9	368	,,
Sciurus hippurus hippurosus	♀	232	255	20	62	58.8	51	26.5	15.3	10	17.5	17.5	34.6	398	,,

Measurements of the *Sciurus notatus* group from North-West Sumatra.

Species	Sex	Head and Body	Tail	Ear	Hind-foot	Skull								No.	Remarks
						Greatest length	Condylo-basilar length	Palatilar length	Diastema	Upper molar row	Median nasal length	Inter-orbital breadth	Zygomatic breadth		
Sciurus notatus tapanulius	♀	183	172	18	41	46.9	39.8	19.6	10	9.8	13.3	16	—	489	Vix ad.
„	♀	196	182	18	43	49	42.4	21.5	11.2	9.5	14.2	18	29.4	490	Adult
S. n. percommodus	♂	187	195	19	45	49.5	42.3	22	11.5	9.5	14.7	17.5	29.3	384	„
„	♂	187	—	18	45	48.5	42	22.2	12	9.2	14	17.9	28.5	372	„
„	♂	188	203	18	47	48.4	41.8	21.1	11.5	9.4	13.8	16.6	—	380	„
„	♀	196	175	18	44	49	41.6	20.9	11	9	13.5	18	29.6	402	„
„	♀	185	199	18	46	49	42.3	21.6	11.8	9.4	13.5	16.1	28.5	401	„
„	♀	191	194	18	46	49	42	22.5	12.8	9.6	14.4	18.3	29	416	„ (type)
S. nigrovittatus bocki	♀	191	157	20	42	47	40	19.9	10.7	8.5	14.4	17.5	29.5	343	Adult
„	♀	172	160	19	42	46.2	38.7	18.5	10.4	8.7	13.2	16.6	28.1	458	„
„	♀	176	151	17	42	45.1	38.2	18.5	10.5	8.7	12.8	16.5	27.1	446	„
„	♂	178	166	18	42	45	38	19	10.5	8.6	13.4	17.2	27.1	422	„
„	♀	167	151	17	42	44.4	37.5	18	10	8.5	13	16.5	28	445	„
S. a. albescens	♂	172	155	17	40	44.8	38.3	19.8	10.5	8.2	12.5	16.6	26.3	306	„
„	♂	157	162	18	40	42.3	35.2	18.3	9.5	8	12	15.3	25.6	441	„
„	♂	167	155	18	42	42.7	36.1	17.6	9.4	8.1	11	16.5	26.9	421	„
„	♀	173	153	17	42	43.4	36.8	18.7	10	8.1	12	15	26.5	452	„
„	♀	172	155	18	42	44	37.8	19.2	10.8	8	11.5	16	26	453	„

Measurements of *Sciurus tenuis* group from North-West Sumatra.

Species	Sex	Head and Body	Tail	Ear	Hind-foot	Skull								No.	Remarks
						Greatest length	Condyobasilar length	Palatilar length	Diastema	Upper molar row	Median nasal length	Interorbital breadth	Zygomatic breadth		
Sciurus tenuis surdus.	♂	138	110	14	33	37.8	31.2	15.7	8.6	6.5	10 5	13	—	342	Adult
„	♂	129	115	16	33	37.8	31.3	15.9	8.5	6.9	10.3	12.6	—	336	„
„	♂	138	110	17	33	37.4	31	15	8	6.7	10.2	12.5	—	355	„
„	♂	129	116	16	32	37.5	31	15.9	8.3	7	10.7	12.9	22	404	„
„	♀	134	112	15	32	38	31.2	15.8	8.4	6.6	10.5	12.8	22.1	413	„
„	♀	—	—	—	—	37	31	15.5	8.5	6.7	11.5	13.2	—	334	„
Sciurus tenuis altitudinis.	♂	134	116	16	35	—	32	16	9	7.1	—	12.4	22	484	„
„	♂	135	119	19	35	—	32.3	16.5	9.3	—	—	12	—	435	„
„	♂	145	118	16	—	—	32.7	17	9.4	7 5	—	12.3	22.8	495	„
„	♀	143	121	18	34	39	33.2	16.5	9.2	7.1	13	13	22.8	479	„
„	♀	148	—	17	34	39.5	32.8	16.9	9	7	11.5	12.7	23.4	434	„
„	♂	146	109	17	34	39.3	32.6	16.4	9.5	7.5	12	—	21.5	327	„
„	♂	136	112	17	32	40.1	32.3	16.8	9	7.6	11.9	12.9	21.4	505	„
„	♀	137	119	17	35	39.8	32.4	16.7	9	7.5	11.8	12	21.8	485	„
Sciurus modestus modestus.	♂	—	115	14	35	—	32.3	16.5	9	7.2	—	14.5	24.5	499	„
„	♀	136	126	15	34	39.5	33.5	—	8.8	—	11.9	13.3	23.6	369	„
„	♀	—	—	15	31	38.7	31.5	16.3	—	7.5	11.5	13.2	23.2	305	„

seems possible that there is an undescribed northern race, but in view of the poor material (one of the present specimens is a juvenile and another is only a young adult), and the fact that a skin from the mountains inland from Medan on the north-east coast is clearly referable to typical *niobe* I do not, at the moment, feel justified in making any further separation.

Rattus rattus jalorensis (BONH.).

Mus jalorensis BONHOTE, Fasc. Malay., Zool., pt. I, 1903, p. 28: Patani, Peninsular Thailand.

1 ♂ Kotatjane, 200 m; 1 ♂, 2 ♀ Simpang Agoesan, 1.000 m; 2 ♂, 2 ♀, Atang Poetar, 1.000 m; 1 ♂ Gadjah, 950 m; 1 ♂, 1 ♀ Lesten, 700 m; 1 ♂ Poelau Moenteh (near Pendeng), 550 - 750 m.

An interesting feature of this series is that the skulls of one or two of the specimens in which the under parts are tinged with grey show certain features adumbrating the characters of the form *argentiventer*. I have not seen such specimens from the Malay Peninsula. For measurements see page 500.

Rattus hoogerwerfi CHAS.

Rattus hoogerwerfi CHASEN, Treubia, XVII, 1939, p. 207: Blang Kedjeren, Atjeh, North Sumatra, 800 m.

1 ad. ♀, 1 juv. ♀ Mt. Leuser; 1 ♀ Blang Kedjeren, 800 m; 1 ♀ Ngo Lemboe, "bivak I", 800 - 2000 m.

This is a brightly coloured brown rat of medium size, with long soft pelage. The tail is longer than the head and body, and white for the distal half. The nasals and the interorbital region of the skull are unusually flattened.

The fur is very soft and long, and excluding the numerous long projecting black piles, is about 20 mm thick on the rump. The upper parts are rich bright brown in colour, sprinkled with black, becoming paler on the flanks, and paling to rufous-buff on the under parts: there is no sharp line of demarcation on the flanks. The base of the fur is everywhere, broadly, grey. The under side of the head is grey. The whiskers are long and black. The feet are blackish, but the digits of the forefeet are white. The juvenile is much duller in colour and nearer to liver-brown on the upper parts. The tail has about ten rings to the centimetre. Mammae 1 - 3 = 8.

The skull has the brain case much inflated as in the *surifer* rats; the interorbital region is slightly hollowed between the supraorbital beading, and the region about the posterior end of the nasals is quite flat.

Perhaps the nearest relative of *R. hoogerwerfi* is *Rattus baluensis korinchi* for if consideration of the tail colour is excluded the two forms are not unlike, and the peculiar characters of the skull of *hoogerwerfi* are to some extent adumbrated in adults of *korinchi*. For measurements see page 501.

Rattus concolor ephippium (JENT.).

Mus ephippium JENTINK, Notes Leyd. Mus., II, 1880, p. 15: Sumatra.

5 ♂, 7 ♀ Poelau Moenteh (near Pendeng), 550 - 750 m; 1 ♀ Gadjah, 950 m;

2 ♀ Palok, 800 - 1.000 m; 6 ♂, 9 ♀ Atang Poetar, 1.000 m.

For measurements see page 500.

Rattus mülleri mülleri (JENT.).

Mus mülleri JENTINK, Notes Leyd. Mus., II, 1880, p. 16: Batang Singalan, West Sumatra.

4 ♀ Lesten, 700 m; 2 ♀ Poelau Moenteh (near Pendeng), 550 - 750 m; 1 ♀ Ngo Lemboe, "bivak I", 800 - 2000 m.

On the upper parts these specimens show the cold colour tone of *mülleri*. Of the four adults, two from Lesten have white under parts sharply defined on the flanks; one from Ngo Lemboe is grey below, with no well-defined line of demarcation; and one from Lesten is more or less intermediate between the two conditions. In the adult skulls the rostrum matches that of specimens from the Kerintji highlands regarded as true *mülleri* by ROBINSON & KLOSS in 1918, and not the lowland specimens described by these authors as *campus*. For measurements see page 500.

Rattus infraluteus maxi SODY.

Rattus maxi SODY, Natuurhist. Maandblad (Maastricht), 21, 1932, p. 157: Tjiboeni, Bandoeng, West Java.

1 ♀, Atang Poetar, 1.000 m.

No topotypes of *maxi* are available for comparison. Judging by the original description of that form it seems possible that the present specimen represents a browner and less grey race. In external appearance it is very like adults of the same sex of *infraluteus* from Mt. Kinabalu in North Borneo, but several points of difference are presented. It is not quite so dark on the flanks, and the line of demarcation between upper and lower parts is therefore less distinct; there is a more definite blackening of the mid-dorsal line, especially on the nape; and the under parts are pale smoky grey, without the buffy tinge seen in *infraluteus*.

The skull closely follows that of a female *infraluteus* of about the same age, but the brain case is more inflated, the parietals are more convex, the dorsal ridges are much more curved outwards and therefore less parallel, and the anterior palatal foramina are much longer than in any skull of a series of *infraluteus* although this includes a skull with a total length of 64.3 mm against 62.2 mm in the Atjeh specimen. For measurements see page 500.

Rattus rajah pellax (MILL.).

Mus pellax MILLER, Proc. Biol. Soc. Wash., XIII, 1900, p. 147: Trang, Peninsular Thailand.

1 ♂ Lesten, 700 m.

This specimen is clearly referable to the Malayan *pellax* and not to the South Sumatran *similis*. The rostrum is slightly narrower than in most *pellax*, but similar skulls do occur in Malayan series. For measurements see page 501.

Rattus rapit fraternus (ROB. & KL.).

Epimys fraternus ROBINSON and KLOSS, Journ. Strs. Br. Roy. Asiat. Soc., No. 73, 1916, p. 373: Kerintji Peak, West Sumatra, 4.700 ft.

1 ♀ Blang Kedjeren, 800 m; 3 ♂, 2 ♀ Atang Poetar, 1.000 m.

For measurements see page 501.

Rattus whiteheadi batus (MILL.).

Epimys batus MILLER, Proc. Biol. Soc. Wash., XXIV, 1911, p. 27: Pinie Island, Batoe Islands, West Sumatra.

2 ♀ Ngo Lemboe, "bivak I", 800 - 2000 m; 2 ♂, 1 ♀ Poelau Moenteh (near Pendeng), 550 - 750 m; 5 ♂, 1 ♀ Lesten, 700 m.

All these specimens are strongly rufous on the under parts, and they cannot be referred to the much duller race, *batamanus*, recorded from parts of East Sumatra. The average size of the skull is too large for typical *whiteheadi* which is found in West Sumatra. No topotypes of *batus* are available for comparison, but on description no separation can be made. Some remarks on large series of this rat were offered in the "Handlist of Malaysian Mammals", p. 180. Comparative measurements are given in Bull. Raff. Mus., 10, 1935, p. 19. In the present series the shape of the palatal foramina is more than usually variable. The measurements given in the table (p. 502) are those of the four largest adults.

Rattus alticola hylomyoides (ROB. & KL.).

Epimys hylomyoides ROBINSON and KLOSS, Journ. Strs. Br. Roy. Asiat. Soc., No. 73, 1916, p. 273: Kerintji Peak, Sumatra, 7.300 ft.

2 ♂, 1 ♀ Mt. Leuser; 1 ♀ Gadjah, 950 m; 1 ♂, 1 ♀ Ngo Lemboe, "bivak I", 800 - 2000 m.

In the original topotypical series of this rat the maximum skull-length was 34.4 mm (the aged type), against 37.5 mm in the present series. It is possible, therefore, that a large northern race should be separated, but the original series of *hylomyoides* was small, and Mt. Dempo, south of Kerintji, produces skulls up to 35.4 mm in length. From Mt. Ophir, north of Kerintji, the skulls of adults run up to 37.5 mm in greatest length. For measurements see page 502.

Rattus bukit lieftincki CHAS.

Rattus bukit lieftincki CHASEN, Treubia, 17, 1939, p. 208: Atang Poetar, Atjeh, North Sumatra, 1.000 m.

9 ♂, 4 ♀ Atang Poetar, 1.000 m.

This rat is very like *R. bukit* of the Malay Peninsula, but the upper parts are brighter in colour; the fur on the under parts is noticeably softer and less spinous; and the average length of the skull is considerably less. *R. b. lieftincki* differs from *treubii* of the Javan mountains in that the upper parts are less brightly coloured; but it is brighter than *temmincki* of the Javan lowlands: *bukit* and *lieftincki* differ from *treubii* and *temmincki* in that the inside of

the thigh is white, not largely coloured; and the brown on the upper side of the foot is much less extensive.

R. b. jacobsoni BARTELS, Natuurk. Tijdschr. Ned. Ind., XCVII, 1937, p. 121 Lampoengs, South Sumatra), was a reference not known to me when *lieftincki* was described, and I have no examples of it for comparison, but in view of the fact that *jacobsoni* and *temmincki* are specifically stated to be alike in cannot be confused with the much duller *temmincki*. For measurements see page 502.

Measurements of *Rattus* spp. from North-West Sumatra.

Species	Sex	Head and Body	Tail	Hind -foot	Ear	Skull								No.	Remarks
						Great-est length	Condylo -basilar length	Diast-ema	Upper molar row	Length palatal fora-mina	Median nasal length	Breadth combin-ed nasal	Zygo-matic breadth		
Rattus concolor ephippium	♂	128	134	25	20	32.5	27.8	8.4	5	6	11.8	3.6	15.7	467	Adult
,,	♂	131	144	26	20	32.7	27.8	8.9	5	6	11.7	4.1	16	423	,,
,,	♂	135	144	26	18	33.2	28.5	9.4	5.1	6.5	12.1	—	15.6	351	,,
,,	♀	120	127	24	17	32.1	27.2	8.4	5.2	6	11.2	4.1	15 5	474	,,
,,	♀	135	135	25	19	32.4	28.1	8.6	5.2	6.5	11.7	4	16.5	470	,,
,,	♀	122	140	26	19	32.7	27.9	8.3	5.2	6.1	12 3	4.2	15.9	443	,,
,,	♀	133	130	24	18	32	27.3	8.1	5.2	5.7	11.8	3.9	15.5	507	,,
,,	♀	—	—	25	18	32.5	27 8	8.4	5.2	5 8	11.9	4 2	15.2	497	,,
Rattus rattus jalorensis	♂	145	157	31	18	–	30.9	9.4	6.4	5.5	—	—	17.5	344	,,
,,	♂	143	165	28	19	—	31.9	9.5	6.6	6.2	—	—	—	319	,,
,,	♂	176	175	34	22	40.9	36 4	11.4	6.9	6.8	14.9	4.5	20.5	494	,,
,,	♂	177	171	32	19	39 9	34	10.6	6.5	6.7	14.5	4.7	19.1	375	,,
,,	♀	160	152	32	18	38	33.5	10.5	6.9	7	13	4.4	19.4	501	,,
Rattus infraluteus maxi	♀	259	298	57	29	62.2	54	17.7	11.1	11.1	25	7	33	486	,,
Rattus m. mülleri	♂	238	236	48	21	53.9	46.9	14.5	10	8.8	21.3	6.1	27.3	—	,,
,,	♀	230	254	47	23	53	46.2	14	10.1	8.2	19.7	5,7	27	328	,,
,,	♀	218	235	48	22	51.2	43.5	13.1	9.6	8.5	19	5 2	24.3	418	Vix ad.
,,	♀	245	283	52	23	55	47	14.5	9.9	8.5	19.5	6.9	27.5	415	Adult

Measurements of *Rattus* spp. from North-West Sumatra.

Species	Sex	Head and Body	Tail	Hind-foot	Ear	Skull								No.	Remarks
						Great-est length	Condylo-basilar length	Dias-tema	Upper molar row	Length palatal for-amina	Median nasal length	Breadth combi-ned nasals	Zygo-matic breadth		
Rattus rajah pellax.	♂	197	201	41	—	47	39.3	12.5	7	7.3	17.9	5.2	21.2	391	Adult
Rattus rapit fraternus.	♂	162	239	33	25	40.5	34	10.2	6.8	7.2	15.2	5.3	17.7	460	,,
,,	♂	160	237	34	26	40.3	33	9.5	7.2	6.8	15.5	4.8	18.3	459	,,
,,	♂	163	—	32	23	41.8	35.3	10.8	6.8	7.5	15	5.3	17.9	455	,,
,,	♀	165	224	33	25	40.7	33.5	10.5	7	7	14.6	5	—	448	,,
Rattus hoogerwerfi.	♀	183	225	37	26	43.3	37.2	10.8	8.1	8.2	14.5	4.8	—	324	,,
,,	♀	173	230	35	23	41.8	35.5	10.5	7.8	7.5	15	4.8	19.8	315	,,
,,	♀	189	257	37	26	41.6	36	10.7	7.5	7.8	14.5	5	20.4	311	,, (type)

Measurements of spiny-backed *Rattus* from North-West Sumatra.

Species	Sex	Head and Body	Tail	Hind-foot	Ear	Skull								No.	Remarks
						Great-est length	Condylo-basilar length	Diast-ema	Upper molar row	Length palatal forami-na	Median nasal length	Breadth combi-ned nasals	Zygo-matic breadth		
Rattus alticola															
hylomyoides	♂	150	155	32	22	—	30.2	8.8	6.7	5.2	12.2	3.5	—	325	Adult
„	♂	156	133	31	21	37.5	32	9.7	6.2	5.8	12	3.4	16,9	314	„
„	♀	149	145	31	21	36.5	30.3	8.8	6.5	5	11.7	4.1	17.1	326	.,
„	♀	147	135	—	—	35.9	29.3	8.6	6.2	5.5	12.9	3.7	16.3	323	„
Rattus white-															
headi batus	♂	147	113	30	18	36.7	30.5	9.3	5.3	5.1	12.2	4	—	406	„
„	♂	143	118	29	18	35.7	30.1	9.1	5.7	5.1	12.4	4.1	15.7	387	„
„	♂	132	—	28	21	36	30.2	8.8	5.5	5.1	12.2	4.1	15.9	508	„
„	♂	133	127	28	19	34.8	28 2	8.2	5.5	4.3	11.4	3.8	15.5	374	„
Rattus bukit															
lieftincki	♂	136	169	28	20	35.7	29	8.5	5.9	5.5	11.5	3.5	—	464	„
„	♂	140	185	28	20	36.5	30.3	9.2	5.7	5.9	12.6	3.7	—	449	„
„	♂	135	168	28	20	36.4	30	9	6	6	13.1	4.4	—	468	„
„	♂	139	185	28	20	36.3	29.5	8.5	6	5.4	12.5	4	—	456	„
,,	♀	150	194	29	19	37	30.8	9	6.3	6.1	13.7	4.4	17	478	„ (type)
„	♀	143	177	28	19	36.5	29.9	8.8	6	5.3	13.4	4.2	16.6	477	„

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